Chimney Construction.

BY R. M. AND F. J. BANCROFT.

EDINBURGH GAS WORKS CHIMNEY.

Designed by Mr. Mark Taylor, engineer to the com any. Mr. Geo. Buchanan. C.E., and Prof. Gordon, of Glasgow, were consulted. Builders—Stonework, Mr. James Gowan, of Edinburgh; brickwork, Mr. James Bow, of Pollocksfield, near Glasgow.

Description.—Square stone pedestal, circular brick shaft.

Dimensions.	ft.
Stone foundation, under ground	6½
Part of base, under ground	6
Stone pedestal; above ground	65
Brick shaft	264
Total height from foundation to top	341½

Height from ground line to top, 329 ft.

Foundation Stone.—40½ ft. square by 6½ ft. deep. The pressure on the bottom of foundation per sq. ft. = nearly 2½ tons.

Pedestal Stone.—30 ft. square at ground line, 27¾ ft. square at the top, 22½ ft. internal diameter at bottom, 20½ ft. internal diameter at top. This was built during the summer, at the end of which the works were suspended until the following year.

Brickwork.—Commenced and finished in summer following the erection of pedestal.

Outer brick shaft, circular:—	ft.	in.
Outside diameter at bottom	26	3
Internal " " bottom	20	5
Outside " " top	15	0
Internal " " top	12	0

This was built up in five steps, as follows:

1st section,	35	ft. high,	3½	bricks	=	35 in.
2nd "	40	" "	3	"	=	30 in.
3rd "	48	" "	2½	"	=	25 in.
4th "	58	" "	2	"	=	20 in.
5th "	83	" "	1½	"	=	15 in.
	264					

The greatest pressure on any part of the work comes at the lowest section, where it amounts to about 8 tons 2 cwt. per sq. ft.

Inner brick shaft, circular:—

This is distinct from the outer shaft, and is 90 ft. high, with 13 ft. internal diameter throughout, and was built in four steps, viz.:

1st section,	14	ft. high,	35	in.	thick.
2nd "	6	" "	30	"	"
3rd "	30	" "	25	"	"
4th "	40	" "	20	"	"
Total	90				

The thicknesses include a lining of fire bricks 10 in. thick for 20 ft., and 5 in. thick for remaining 70 ft.

Materials.—The weight of materials is about 3,700 tons.

Cost.—Total, £4,637.

Lightning Conductor.—Solid copper rod, ⅝ in. diameter.

Stone.—The stones used in the foundation are Cragleith, Humbie, and Hailes, and before use were tested by Mr. Buchanan and Mr. James Gowan. The tests were made in the most careful way by crushing cubes of 1 in. square. Results of tests:

Crushed at	
Cragleith	315 tons per sq. ft.
Humbie	240 " " "
Hailes	225 " " "

A second test of Cragleith showed that before being crushed to powder, it sustained a pressure of 440 tons per sq. ft. The appearance after fracture of the different cubes was that of a pyramid or wedge, and this led Mr. Gowan, to assert that if the cubes were enlarged a greater increase of strength would be gained, and, further, that if the pressure were *vertical* to the line of cleavage a greater resistance would be obtained, so that such a stone as Hailes, which is a laminated stone, would increase in strength according to its surface, more in proportion than that of a liver rock stone, such as Cragleith. This led to discussion and further tests, the results being that with a 4 in. cu. from Hailes' quarry, the resistance was = 567 tons per sq. ft.

Bricks were supplied by Mr. Livingstone, of Portobello Brickworks, and were tested with the following results:

Description of Specimen.	Length.	Breadth.	Thickness.	Weight.	Crushing wt. on each brick.	Crushing wt. per sq. ft.
	ins.	ins.	ins.	lbs.	Tons.	Tons.
Extra size and quality	10	5	3	10⅝	153	440
Do. do	9½	4⅝	2¾	9⅛	140	448

NEWLAND MILL CHIMNEY, BRADFORD.

Built for the late Sir H. W. Ripley, Bart., in 1862-3, by Messrs. John Moulson & Sons.

DESCRIPTION.—OCTAGONAL STONE.

Dimension.	ft. in.
Total height from top of concrete shaft	360 0
Height from ground line	340 0
Concrete foundation sq.	32 6
Outside measurement on stone footings	24 0
Inside diameter	12 2
Outside measurement at ground line	24 0
Inside diameter "	12 2
Outside measurement under cap at top	14 6
Inside diameter "	9 0
9 in Firebrick Lining.	ft.
Height from top of footings	30
Inside diameter throughout	9
Withe or division wall from footings	10

Foundation.—The site was an old coal shaft, which was filled up with Skipton lime concrete, forming a center pillar 8 ft. 6 in. diameter. Round this were constructed four other shafts, each 6 ft. diameter, also of concrete, the sinking of which cost 9s. 6d. per yd. per shaft. Upon above formation was laid a tabling of lime concrete 32 ft. 6 in sq. by 2 ft. 6 in. thick, the base courses or footings of the chimney resting upon it. The concrete was not rammed or pounded, but was tipped in from staging; it was almost liquid, and nearly levelled itself by the drop. The old workings surrounding the center shaft were packed with stones and oak wedges. The amount of contract for sinking four shafts, packing coal beds, cleansing and searching old working, and ascertaining condition of ground was £104 17s. 9d.

Materials.—Outer stone casing, stone backing, and 9 in. common brick lining throughout, fire brick at bottom.

Weight.—Total, 3,600 tons; above cuts, 2,230 tons; pressure, 4½ tons per ft. sup. of foundation, 22.4 tons per ft. sup. on 5 concrete piers.

Contract.—The construction of the chimney was settled as follows:—The late Sir H. W. Ripley, Bart., being desirous of erecting a chimney, sent for Messrs. J. Moulson and Sons in May, 1862, to give a tender. There were no plans or specifications prepared when the tender was given, but the following formed the basis of the estimate:—Chimney to be 80 yds. high, 9 ft, flue, base 24 ft. sq., with two courses of footings 12 in. thick, the first 28 ft. sq., the second 24 ft., placed on a good bed of concrete. The builders undertook to execute the work for £942 5s. 10d. The ashlar foundations, concrete, and capping to be extra.

Building.—At the ground line the chimney was a regular octagon, and was so continued upward at a regular batter of ¼ in. to the yard. The chimney was commenced July, 1862, and continued to the middle of December (the back end of the year being open), the building was then suspended, being a little more than 120 ft. high. The work recommenced 28th February, 1863. "Through" stones were built in at about every 3 ft. in circumference, and about 2 ft. 3 in. apart vertical. The erection was continued to the 7th June, the chimney having reached 210 ft. in height.

Straightening.—On the evening of the 7th June the chimney was left plumb. On the 8th it was found to be bulged on one side, and hollow on the other. About 54 ft. from ground line a course of stones was cut out on the opposite side to the canting over. Two men outside with long chisels cut away, say, for 1 ft. wide on the outside a 7 in. stone course, and through the backing; two men from the inside cut through the brick lining, and meeting the opening, cut through the backing from the outside. This space was filled up with stones ½ in. less in thickness; upon these were placed long, feather-edged iron wedges to make up the original thickness. This operation was continued nearly half-way round, with the exception of the angles, which were left. Before proceeding to draw the wedges, mastic cement was introduced by means of syringes. The wedges were then withdrawn by hammering them sideways both from inside and outside. As the wedges were removed the men could hear the "through" stones breaking. The first cut did not have the desired effect, and a second was decided upon about 2 ft. above the first, with the same results as to breaking the throughs. The chimney was after this declared to be perpendicular. In the "coming to" the corner stones at the angles were crushed for about 12 ft. above and below the cuttings; these were replaced, and the chimney was then completed.

Cracks.—Three years after completion the chimney was found to be cracked and broken on the side opposite the cuts. This was repaired at a cost of £96. About 1872, further cracks were noticed, which were repaired. In October, 1882, the tenants of the mill became uneasy about further indications of cracking, which in December developed into bulges. Upon examination it was decided to take out the bulges and repair the outer casing, it being the general opinion the latter was alone at fault. Difficulty was experienced in this, and the attempt to rectify the bulge failed.

Collapse.—On the 26th December, 1882, small portions of the outer casing dropped, and on the 27th a large piece fell, breaking down the scaffold used for the repairs. On the night of the 27th the wind blew half a gale, or about 16lb. per ft. sup. On the following morning, 28th December, more of the outer casing fell, and at a few minutes past eight a. m. the chimney began to settle, bursting out stones and lime near the height where the chimney had been cut. This continued for a few seconds, then the upper portion of the chimney fell in a south-easterly direction, killing 54 persons and destroying property estimated at £20,000.

TAKING DOWN CHIMNEYS.

An ingenious arrangement for facilitating the taking down of an old chimney shaft was employed at Messrs. Gilkes, Wilson, Pease and Co's Tees Iron Works, Middlesbrough, and was designed by the engineer of the works, Mr. Chas. Wood. In consequence of the chimney shaft on which this arrangement was employed standing in a crowded position the plan of letting it fall was inadmissible, and it had to be taken down from the top.

The bricks had to be lowered with as little damage as possible, so that they might be used again for building purposes. Owing to the position of the chimney the bricks could not be thrown down outside, and if thrown down inside they would have been smashed, or if lowered by mechanical means the process would have been very tedious, and was impracticable.

Under these circumstances it was considered whether the bricks could not be allowed to fall by their own gravity, and at the same time be cushioned sufficiently to break their fall and prevent damage. In order to do this an air-tight iron box was placed at the bottom of the chimney; this box was fitted with an air-tight door, mounted on hinges and closing on an india-rubber face, against which it was tightened by a wedge.

A wooden spout was then fixed on to the top of the box and carried up the chimney, it was 3½ in. by 5 in. inside, and was made of planks 1½ in. thick well nailed together with a little white lead on the edges, thus making it air-

tight. The spout was made in about 12 ft. lengths, and these were joined together by cast-iron sockets or shoes, and corked round with tarred yarn, the whole apparatus costing about £6.

A few stays were put inside the chimney to keep the spout steady, and steps were nailed upon it by which the men ascended. It will be seen that the whole of the spouting being air-tight, if a brick filled the spout it would not descend; but as the section of a brick is 3 in. by 4½ in., and the spout was 3½ in. by 5 in there was a quarter inch space each way through which the air could pass the brick freely, the space further allowing for any irregularity in the sizes of the bricks. The result was, that the bricks being cushioned in their fall arrived at the bottom without any damage. As soon as the box was full the man at the bottom rapped on the spout as a signal to stop, and then opened the air-tight door and removed the bricks inside. This being done he shut the door and signalled same to the man at the top. The man on the top lowered his own scaffold, and as the spout became too high he cut a piece off with a saw. If there was much mortar adhering to the bricks, it was knocked off before putting the latter into the spout, and such mortar, etc., was allowed to fall inside the chimney and was afterwards wheeled out.

The plan described was, we believe, quite novel, and was certainly simple and ingenious. There are, no doubt, many similar circumstances under which it might be advantageously employed.

WROUGHT-IRON CHIMNEYS.

Wrought-iron shafts have found great favor in America and Russia, but in England and the Continent generally, as far as we have been able to ascertain, they are an exception. In ddition to the wrought-iron shafts detailed in this paper we have been informed of the following: Messrs. Witherow and Gordon, of Pittsburg, Pennsylvania, U.S.A., have since 1876 built upwards of thirty wrought-iron shafts, varying in height from 100 ft. to 190 ft., and from 5 ft. to 9 ft. in diameter. The firm write us that these shafts answer admirably the purpose for which they were built. L. S. Bent, Esq., Superintendent Pennsylvania Steel Company, Steelton, Pa., U.S.A., states that his company have the following eight wrought-iron shafts in use, and have found them both durable and economical:

	ft.		ft.	in.			
No. 1 ...	170	high,	6	6	dia.,	built	1881
1 ...	165	"	6	6	"	"	1877
1 ...	135	"	7	0	"	"	1880
1 ...	112	"	6	0	"	"	1881
4 ...	110	"	7	0	"	"	1869, 74-5-6

They are lined for 30 ft. with 9 in. fire brick, and the remainder of height with 4 in. red brick.

RAVENSDALE IRONWORKS CHIMNEYS SHAFT, TUNSTALL.

(Messrs. Robert Heath and Sons.)

Description.—Circular wrought-iron shaft, not spread at base.

Dimensions.	ft.
Height from ground line to top	75
Outside measurement at ground surface, diam.....	6
Ditto, top, diam.....	6

W. I. Plates.—No. 75 W. I. plates were used in the construction of this shaft, the thickness being ¼ in. The plates have a lap of 2½ in. and are riveted together with ⅝ in. cup-headed rivets.

Firebrick.—The shaft is lined its entire height with firebrick.

Duty.—The shaft carries off the fumes from three boilers.—London *Contract Journal.*

ENGINEERING NEWS: Three months for One Dollar.

The 16th Annual Convention of the American Society of Civil Engineers.

(*Continued from page 303.*)

BUFFALO, N. Y., JUNE 17, 1884.

EVENING SESSION.

There was a very full attendance. Mr. T. Guilford Smith presided, and after opening the meeting explained that Mayor Scoville had been unavoidably detained at Rochester; he also read the following letter of regret from Mr. E. L. Hedstrom, who was to have addressed the meeting:

Mr. T. Guilford Smith.

MY DEAR SIR—On my arrival in the city to-day at noon, I find my physical condition to be such that it seems prudent for me to remain at home this afternoon and evening.

I sincerely regret this indisposition, and were I to allow my inclination to overcome my prudence, I should do myself harm and your society an injustice by attempting to address you to-night. I congratulate you and the citizens of Buffalo that it has become possible for us to extend our hearty greeting, and welcome to our city and homes to such a large body of scientific gentlemen as compose the American Society of Civil Engineers.

Kindly convey my regrets of inability to be present at the reception and greatly oblige,

Yours most sincerely,
E. L. HEDSTROM.

717 Delaware avenue, Buffalo, June 10, 1884.

After the reading of the communication, Mr. Smith introduced Ald. R. R. Hefford, President of the Common Council, whose words of welcome were as follows:

Mr. President, Ladies and Gentlemen:

Whoever is permitted to give greeting to such an eminent body should indeed have something worthy, something wise to say. I have to regret that the privilege of welcoming you to our city had not fallen to the lot of one better able to express to you that warmth of hospitable feeling which I know our citizens entertain toward your society, and which I trust you will feel ere you turn your faces homeward.

Looking back over the political and commercial history of our country and of the advancement of our people in things material, and seeing upon it all the imprint of the master mind of the American engineer, we cannot but feel honored in being permitted to offer you entertainment at this time.

In that great struggle of our forefathers for independence we find the central figure, the great captain that led them to victory, known to the world as an honored member of your profession, and in every conflict since that day we have seen members of your profession taking an active and leading part. History teaches us that in all ages man's principal avenues of trade and travel have been along the parallels of latitude from east to west and west to east. When the white man undertook to open up this great continent to the commerce of the world, and to develop lines of communication between the east and the far west he was met by awe-inspiring barriers of nature running north and south in the form of lofty mountain ranges, deep valleys and mighty rivers. But owing to the genius of that pioneer of trade and commerce, the American engineer, who pierced the mountain, bridged the valley and the stream, and made straight the way for the great iron highways of commerce, these barriers, formidable as they were, were not permitted to obstruct the tread of man toward the setting sun, or to prevent the adding of one more link to the tie that binds the States in union. But, Mr. President, our State as well as the Nation is indebted to your profession for many of its features of prosperity. The traveler entering the harbor of our metropolis is met on every hand with the evidences of the skill of our civil engineers, and as he nears the city there opens up to him a view of that grand structure of grace and beauty, the East River Bridge, which is to stand for ages a monument to the genius of the American engineer. And should the traveler desire to meet with you here, there are open to him six iron arteries of trade, which invite him to the luxury of modern railroad travel, and parallel to these lines of travel and to which we would call his attention, is that most useful but somewhat aged example of the handiwork of the American engineer the Erie Canal, a work which has returned its builders over forty million dollars more than it cost, and made this State what she is—the Empire State of the Union. Its commerce laid well the foundations of as thriving a lot of cities and towns along its bank as the sun is permitted to shine upon, and all this was accomplished before its rival had laid a rail or passed a dividend. A fear has been expressed, Mr. President, that this grand old waterway would by the dust of competition be dried up, but the people of this State have determined that her waters shall moisten the lips of commerce for a while longer and her gates be thrown open as a free highway to the commerce of the world.

We would be pleased while you are here to show you our harbor, located on a stream that at one time was fordable and on which the early settlers concluded a harbor could not be built; but the hand of science solved the question, and by the judicious placing of breakwater and pier, one of the finest harbors on the great lakes has been constructed, thereby enabling us to attain an enviable position among the cities of the world as a grain-receiving and coal-shipping port.

We shall also be able to show you in this vicinity some results in the science of engineering and bridge building, in which we have a local pride and in which we are ready to join with your society in congratulating those of our number who were instrumental in bringing about the accomplished fact. As you pass through our city and observe our streets and parks, the extent of our railroads and manufacturing interests, it will be apparent to you that the American engineer has not been idle in this part of the country, but rather that he has done his full share toward placing the country at large, and this community in particular, under lasting obligation to the profession so honorably represented by your society.

A short time since I had the pleasure of joining with others in a letter extending an invitation to your society to hold its annual meeting in this city. I now desire in person to thank you for your favorable response to that invitation, and on behalf of the municipal government of our city to extend to you, Mr. President, and through you to each member of your society the hand of greeting and assurance of a sincere and cordial welcome to the city.

As Ald. Hefford concluded, a hearty round of applause was accorded him by the audience. President Whittemore responded as follows:

The President of the Common Council of the City of Buffalo:

SIR—Aristippus, the Socratic philosopher, when thrown on the coast of Rhodes by shipwreck, perceiving geometrical diagrams thereon, exclaimed to his disheartened companions: "Be of good cheer, I see marks of civilization." Guided by them, he made his way straight to the city of Rhodes, where by his great learning he secured not only honors to himself, but food and raiment for his companions. So impressed was he of the value of knowledge that he bade his companions, on their return home, to secure for themselves and their children those possessions which neither the changes of fortune nor devastation of war could injure.

Not by disaster, but in quest of knowledge and through the fame of your fair city for its many objects of great interest to the civil engineer, we have come among you to hold our annual convention, and find on every hand more than geometrical diagrams that attest the industry and intelligence of your citizens; marks of civilization that have rendered this locality famous throughout our continent; works of the civil engineer designed for the comfort, convenience and commercial prosperity of your people. We also recognize that we are at the place where terminated one of the great works of the early American engineer, the building of which was fostered by, and which since its completion has been maintained by your great commonwealth, and from which all the States of the West have received substantial benefit. We also recognize that here and in this proximity are to be found some of the noblest works of modern engineering.

Words fail me in attempting to acknowledge to its full extent our appreciation of your kind and eloquent expressions toward the profession we have the honor to follow. Your kind greeting and hearty welcome shall find a pleasant resting-place in our hearts until long after this convention shall have become a circumstance of the past, as long as memory remains to us, and we shall nourish the hope that in the future, through increased knowledge and experience, we may, as a profession, merit that regard you have so generously accorded us to-night.

With this acknowledgment President Whittemore read his annual address, which was as follows:

ANNUAL ADDRESS OF THE PRESIDENT.

Members of the American Society of Civil Engineers:

GENTLEMEN—The high object of our profession is to consider and determine the most economic use of time, power and matter. In this we are gravely responsible, not merely to ourselves, nor yet alone to this society, but to that large, restless and progressive portion of the civilized world which our organization assumes to represent. Upon the results of your industry and study largely depend the fortunes of a great people and the future of a continent yet in the infancy of its physical resources and material power. I am confident that the consciousness of these relations of our profession to human progress will never fail to prove a controlling incentive to duty and fidelity in your relations to this society, and in every field of labor to which you may be called.

It gives me special pleasure to assure you of the present prosperity of our society, and of its rapid progress in all the necessary conditions of permanent usefulness and strength. The number of persons now connected with the organization in all relations, is 837, of whom no less than 622 belong to the grade of members of the first class. It has been, and I trust it will continue to be, the policy of the society to accept for membership of any class, only such as are properly entitled to membership under the wise provisions of your by-laws.

Without attempting to give in this address a detailed statement of the engineering progress of the past year, I briefly call your attention to the works of our Canadian brethren, in deepening the channels of their rivers; in building their railway across the continent, and in the discovery by a member of this society of the Rogers pass through the Selkirk range (happily bearing the name of the discoverer), thereby assuring the early completion of the magnificent enterprise of connecting the two oceans by rail on provincial territory. I also congratulate you upon the rapid progress of railway construction in Mexico; increasing in the last few years from a mileage of three hundred to three thousand miles of completed lines at the present time.

Among the important subjects legitimately under consideration by our society at the present time is that of reckoning and denoting time. It is not surprising that members of our profession should have been the first to suggest practicable reforms in this direction; and it is a gratifying fact in the history of our society, that the energetic support you have given to the establishment of standard meridians of time in the United States, and the intelligent industry of your committee in distributing its printed publications on this subject have contributed probably more than any other cause to the adoption of this reform over a large portion of this continent. Something remains to be accomplished in order to fully realize our views in this direction, a step so natural and simple in the path of rational progress that no serious argument is required to establish its value or propriety. If he who causes a blade of grass to grow where none grew before, is a benefactor to his race, so is he a benefactor to his race who enables us to economize time and space by the use of one word instead of three in the notation of time.

Hence it is not strange that the members of our profession, with great unanimity, favor the numbering of the hours consecutively throughout the entire day, instead of dividing each day into halves of twelve hours each. We are fully aware that we contend with the prejudice of custom in our attempts in this direction. That great agent of modern civilization, the railway, rendered the adoption of standard time possible. Now if that great agency in public education, the press, will adopt the proposed reform in its record of the daily hours, it is believed that "ante" and "past meridian" time will soon be relegated to the past. The labors of your special committee on standard time have been so fruitful in practical results thus far that I submit for your consideration the desirability of its continuance, in the hope that its past and future appeals to the good sense of the public may result in the accomplishment of i s full desires.

Our older members have observed with deep concern the rapid denudation of our forest lands, and the demands of increasing population bring questions of grave moment to the minds of every thoughtful engineer. Returning to the home of my boyhood, with the recollections of only one-third of a century, I find now bare rocks and crags that in my youth were covered with a luxuriant growth of those green forest trees whence my native State derived its distinctive name. Visiting the great pine regions of the northwest, we find the railway pushing its iron arms into the depths of the forest seeking the lumber demanded in the settlement of those great treeless tracts of our continent west of the Mississippi and Missouri rivers. Like conditions are found all over our continent wherever our work leads us. Though many may imagine that the supply of timber cannot be exhausted in the near future, we know the fact that stumpage has nearly doubled in value in the last decade; and I am assured by authority deemed reliable, that the aggregate amount of standing pine in the States of Wisconsin, Michigan and Minnesota, does not much exceed eighty billion feet, while the present annual cut in these three States is eight billion feet—the average cut per acre being about five thousand feet. Many of our railway companies in the west now find in the transportation of lumber their principal item of traffic. On some of the streams of Wisconsin the conversion of logs into lumber is so rapid and of such volume that navigation is impeded by bars of sawdust. It is estimated that the tonnage from one acre of pine land equals the average of agricultural products subject to transportation that is likely to be raised on the same area in from ten to thirteen years. In view of these facts is it not pertinent to ask, how the rapid diminution of this now cheap and chief resource of the engineer and architect for constructive purposes is to be compensated in the future? It is not in the power of man to arrest the demand, and I assume that it would not be policy to do so were the power granted. It is within our province of duty, however, to suggest processes by which decay may be arrested in degree, and to that end you have wisely appointed a special committee. I understand that this committee has collected valuable and voluminous data which may prove of great value in the solution of this important problem. I do not understand that the committee will make more than a partial report of progress at this convention.

I note with pleasure the growing interest, shown by our profession, in investigations as to the manufacture, use and properties of that peculiarly valuable and necessary material in all important works of construction—hydraulic cement. Unlike any other constructive substance, when properly made and used, it neither corrodes nor decays. Its special and peculiar value is further manifest in the fact that it has the property of increasing in strength with age, thus reversing the ordinary law of decay, in conformity with the adages, somewhat different but both true, that "when one hundred years are past and gone, good mortar turns to stone," and that "at one hundred years good mortar is but a child." The ancients conferred hydraulicity on their mortar through the use of puzzulana, and through its employment the constructions of the Romans, eighteen hundred years ago, exhibit less of the destructive effects of time than the works in England of one thousand years later date, in which hydraulic mortar was not used. The first use of an artificial hydraulic mortar in England was by Smeaton in building the Eddystone Lighthouse. This has resisted the wash of the waves for one hundred years, and is now replaced by a more modern structure solely because the abrading of the natural rocks on which it rests threatens its destruction. Quite rarely distributed over our own continent and more rarely in perfect combination for our purposes, we find certain transitory rocks, generally lying between the distinct geological formations, and partaking somewhat in composition of the under and overlaying formation from which this wonderful product is manufactured. By the agency of fire we undo the carbonizing process of nature in the formation of the rock, and bring the product to a condition convenient for our use, when under proper manipulation nature resumes her right to impart strength and solidity to the mass.

The manufacture of this material constitutes one of the largest and most important industries of the country at the present time, and its comparative value, with the proper methods of testing value, and of attaining the largest results by accurate manipulation, are subjects which seem to demand rigid and systematic investigation by this society, and all intelligent engineers engaged in practical construction. Should it be determined by such investigation that the value of the American product, according to the opinion of many eminent authorities, is equivalent to the foreign product under certain conditions at less cost, or sufficient for all practical purposes in engineering, much would be gained to the country in an economic sense, and to this result our profession cannot be indifferent. Therefore, it is pertinent to ask whether in our works, and also in those of the architect, this remarkble substance has been understandingly and generously treated and applied as its merits and true economy demand. Is it generally understood that the subtraction of one measure of sand from our very common specification, that mortar of cement should be composed of one part of cement with two of sand, nearly doubles the strength? This I find to be true in the average of experimental tests made by myself upon sixteen different brands of our American product. Or is it generally understood to what extent hydraulic mortars should be applied as a source of health durability and strength, in structure of either ordinary or extraordinary character? Many years ago, it will be remembered, the men, women and children of this country in a spirit of patriotism subscribed their mites toward the erection of a monument to be erected to perpetuate the memory of "the father of his country," the surveyor Washington.

In 1848 sufficient collections having been made to warrant its commencement, its corner stone was laid, an artist having been first employed to design the structure and a stone mason to build it, and in the following eight years the shaft was carried to the height of 156 ft. In 1876 its completion was intrusted to a distinguished member of our society. Evidently neither the artist nor the stone-mason had any idea of the strains that would be required in a structure of this magnitude, and you are all aware that a new base of cement, extending over 2½ times the area as orginally constructed, has been inserted to secure the stability of the shaft. Although it is of record that the original commission having this work in charge did purchase a small quantity of hydraulic cement, an examination of the old mortar excavated for the purpose of inserting the new base, showed a free use of quick-lime mortar and hardly any indications of cement. Visiting this work at the time, I took therefrom mortar that had lain there a third of a century, and found it as soft as if a week old. Are not mistakes parallel to this being made to-day by both professional engineers and especially by architects? By reason of the great utility of the modern vertical railway, many buildings are being erected of heretofore unparalleled height, requiring thick and massive walls. In many instances, are not these walls laid solely in quick-lime mortar, in which the exposed part becomes carbonized, thereby shutting off the supply of air to carbonize and solidify the interior, whereas the induration of hydraulic mortar is an act of crystalization and takes place alike throughout the mass? The one is also an absorbent of water and under its influence remains soft or crumbles under pressure, while the other is an expellant of moisture, except in so far as necessary for crystalization.

I will not take your time in an extended illusion to standard products from abroad, found especially useful when a maximum of strength within a brief time is deemed essential to the progress of the work. At least four-fifths of the cement used in this country now is of American production, sometimes variable in character because of want of uniformity in manufacture or manipulation, and therefore in works of special importance, often requiring special examination and special attention in manipulation and proportion of mixture. The experimental study of this product is one of exceeding fascination and importance, and I suggest to those of our members who are in charge of educational institutions, the propriety of imposing upon pupils in any department relating to the duties of our profession the necessity of a complete practical knowledge of the manipulation of mortars and their properties, as a condition of graduation and of fitness to enter the profession. Perhaps in this way we may ultimately find one of our profession in this country who will make the matter his life's study, like Vicat, who devoted thirty years of his life to roaming over France in the pursuit of knowledge in this department. Your special committee on "Uniform Tests of Cement," have formulated a partial report which I trust will receive your earnest attention.

Intimately connected with the subject last presented, is that of concrete foundations for street pavements. Careful and somewhat extended experiments in this direction were instituted some years since under the responsible supervision of a distinguished member of your society. Results in this country thus far are alleged to have equalled the highest anticipations, as to durability, cost, and the public convenience, and especially in respect to those sanitary questions so largely involved in all enlightened municipal administration. In fact, there are now few large cities in the United States in which this character of foundation may not be found exemplified in association with surfaces of various material, including wood, stone and natural asphaltum. The latter material, natural asphaltum, has but recently become an important factor in American commerce, and fortunately exists in great abundance within convenient access from our seaports. The recent beneficent actions of our State department, through its consular agen-

cies, reveals to us the interesting fact that "a variety of bituminous substances from the pure hard asphaltum to the fluid naphtha and petroleum, are known to exist in immense quantities along the coast of the Gulf of Mexico," and that inexhaustible beds of nearly pure asphaltum are found near the port of Tampico, and at other points in Mexico, and also the islands of Cuba and Trinidad, all at command of American capital and enterprise. [See "Commercial Relations of the United States"—Nos. 28, 31, 38—1883.] In view of the many purposes for which this cheap and abundant material is believed to be useful, and its rapid increase in public favor, I submit to you the question whether the circumstances do not justify a more definite consideration of its essential characteristics and practical value in connection with our profession.

In sewerage works, the year that has past has been especially marked by the completion of the new outlet for 'improved sewerage' of Boston. This has cost over $4,000,000. It comprises several points of unusual interest. The sewerage of the little city of Keene, N. H., has been completed and brought into use. The system in use here is a strictly separate one, with automatic flushing. The same system has been adopted for Charleston, S. C. The point of discharge will be into a pumping well considerably below low water level. In the country at large constantly increasing interest in sewerage matters is being shown, and the outlook for engineers engaged in this branch of the profession is very favorable.

The world's production of pig-iron has increased from 10,500,000 tons in 1869 to 20,500,000 tons in 1882. If the latter quantity were manufactured into a solid rod of iron one foot in diameter it would be of sufficient length to girdle the world. In 1874, the total production of steel ingots in the United States was less than 200,000 net tons; in 1883, this reached 1,654,000 net tons, of which 1,300,000 tons were converted into rails. The price of steel rails has fallen from $90 per ton, in 1874, to about $35 at the present time. I am advised of a late sale in England of nearly 50,000 tons of steel for bridge work, consisting of plates and angles, the former at 1.73-100 cents per lb., and the latter at 1.63-100 cents. This steel is guaranteed to have an ultimate strength of from 28 to 30 tons, an elastic limit of 18 tons, an elongation of 20 per cent. before fracture, and a contraction of area at fracture of from 43 to 45 per cent., carbon 15 to 20 per cent. In addition to the problems relating to the safe and economic use of iron yet unsolved, we must now give our earnest attention to those pertaining to the many grades of steel. We desire to know what precautions are necessary to be observed in its manipulation into the forms desired for construction purposes. The great problem of the experimental determination of the compressive strength of iron columns is not yet satisfactorily solved. We know but little of it in steel. Can we safely assume that the same ratio exists between the tension and compressive strength of columns of steel that we have in iron? Tensile tests are made with comparative ease, while tests of columns are difficult and expensive, and the results vary per unit of measure according to length of the specimen tested and its form. We have a multiplicity of tensional tests and few of compression. The relation between the weight of compressive members and those in tension, in our bridges of 100 ft. span and over, is nearly as 5 is to 4; hence it follows that our greatest uncertainty as to the strength of the structure is confined to its larger portion.

You are all aware of the action taken by this society through its officers and its committee, in former years, in regard to the subject of tests of structural materials, and that its labors have been fruitful to some extent. We cannot expect that a series of experimental tests, such as are demanded, can be secured except through governmental aid, and it seems fitting that they should be so made. You have been informed by circular that there has been included in the official book of estimates of the war department a recommendation that Congress make certain appropriations in furtherence of tests of materials. I have lately learned that the recommendation has been transferred, in a modified form, to the sundry civil service bill of appropriations and its ultimate fate I cannot conjecture. In a conference with the chief of ordnance, under whose direction tests of this character are made, subject to a previous conference with that officer by a committee of this society, I found him keenly alive to our wants, willing and anxious to undertake a work that would bring such rich results for the public good.

Our duty toward the question of tests of structural materials will not end with this or the next Congress. Our government has in its employ a servant which might be made to utter a volume of grand truths on this subject, I refer to the Watertown testing machine. To this end, the material aid of the government is an essential condition. Should this aid be extended, we might then have reason to expect that facts far more eloquent than words from human tongue would fall from this marvellous invention of man, facts which will bring forth splendid results in the office of the engineer and the architect, and finally enable our States to enter in their statutes laws by which unworthy members of either profession may be convicted and punished in case of disastrous incompetency, a protection to the public and to the meritorious members of our profession now difficult to secure. May that cry of the little child that went out through the smoke and flame of that terrible night at Ashtabula, "Save me mother!" ring in our ears, and reverberate in our hearts until all of us are prompted to perform our full duty in forwarding by all proper effort the solution of all questions arising in our profession on which the security of human life depends.

When in every large city I see the evidences of human progress in the wires of those marvelous appliances for the convenience of man, the telegraph, the telephone, and the electric light, a metallic web across the face of the sky; when from my office window I look upon the site of the Newhall house conflagration, and see the wires still there upon which personal friends leaped to their death, I am forcibly impressed with the conviction that the engineer and the electrician must join hands and heads in their endeavor to eradicate the great evil involved in the present arrangement. In our attemps in this direction we must not lose sight of the benefits we have received from these appliances heretofore, their great necessity at the present time, the capital invested and the great interest at stake that may be injuriously affected by unwise or hasty legislative action. This is a subject now pressing upon your attention and demanding that serious and earnest consideration you have been disposed to accord in years past.

The continuous increase in the commerce tributary to the great valley of the lakes, and in the facilities of water and rail transportation eastward from a vast agricultural region yet in the infancy of its productive, power, command to your approbation and support every practicable plan for promoting efficiency and economy of transportation from the lakes to the seaboard. Therefore, I feel assured that you will give thoughtful attention to the paper that I understand will be read at this convention, treating of the practicability of the enlargement of the Erie Canal, to the end that lake vessels of the largest size may pass to tidewater without break of bulk. Undoubtedly there can be found among our members those who from their knowledge of the physical obstacles to be encountered in such an undertaking are qualified to discuss this matter with that degree of intelligence importance its demand.

It is my hope to be able to present to this convention, some reliable information as to the success of the reservoir system about to be exemplified at the head of the waters of the Mississippi River. The object is to impound the surplus waters of spring and early summer for subsequent utilization in the interest of navigation during the periodic return of the season of low water. But I find that this work is not sufficiently advanced to permit me to give any experimental data of value at this time. The plans at present under consideration by the engineer in charge of that work, refers not only to the head water of the Mississippi, but also to those of the St. Croix, Chippewa and Wisconsin Rivers; and it is his calculation that from the entire resources there at his command, 14,600 cu. ft. of water per second can be drawn for a period of ninety days and practicably a similar quantity be added to the discharge of the Mississippi below the mouth of the Wisconsin, during that period of time when navigation is ordinarily obstructed because of the deficiency in the depth of water. Should the experiment prove successful to the degree anticipated, it may then be of moment for us to determine how far any similar plan may be applied, not only for the purpose of aiding navigation, but in ameliorating the condition of those many portions of our country periodically subjected to destructive inundations, often attended as recently, by the loss of many lives and millions of dollars in property.

It may be asked why we hold these annual conventions at places widely separated over the continent. Among other reasons to be given is the sufficient fact that we are thus enabled to observe and study the works executed by our members in the only perfect records and illustrations extant—in the channel cut by human agency at the mouth of the Mississippi River; in the steel arches that span the same mighty stream at St. Louis; in the first cantilever bridges of American construction at Kentucky River and at Minneapolis; in a like magnificent structure in the vicinity of our present place of meeting, and in hundreds of similar achievements which first had existence as a vision woven in the brain of the civil engineer; each a volume of instruction in principles and practice, and a source of boundless inspiration to all those members of our profession endowed with the capacity of comprehending the visible monuments of human genius and skill. During our present session, we expect to behold that most marvelous evidence of nature's own majesty—Niagara. The artist and the poet have worshipped in picture and song all that is beautiful and picturesque in that mighty torrent, and to all of you who love nature in concrete forms of beauty and grandeur, this phase of adoration is not denied. But as true disciples of our profession, we may see more than this in the mighty power of the sun, first exerted upon the great water-shed of the lakes, expending its excess of non-converted force in the abyss below the great fall—a vast and perpetual power passing forever to useless waste, while man stands dumb in the presence of the gigantic loss, his skill paralyzed and his genius defeated by the very immensity of the ruin. Surely, the mission of the engineer cannot be deemed to have been fulfilled or fairly appreciated, until the abundant voluntary forces of nature have been conserved in a far greater degree than now—until wind and tide, and all the forces of earth and air shall have become the willing servants of man.

It cannot be assumed that knowledge acquired from practical observation, as valuable as we know it to be, in any large degree supplies the place of either an established and perfected literature or mental education. In every pursuit, as a distinguished member of our society once said, "when a man has learned how to learn, he can quickly learn anything." Much of the past and present indeed may be learned by such observation, and by actual labor in the field. But the ideal engineer is one who knows far more than can be taught him by sight or manual experience. By necessity he is concerned in a knowledge of all the sciences, and by an equal necessity he is dependent upon an intimate knowledge of all the abstruse principles of science. It is his duty both to create and apply knowledge. He must know the past with all its noble examples and grand experiences—but he must also comprehend the future, and be constantly prepared for its successive revelations and infinite possibilities. Hence we need a literature far more complete than that we now possess; and still more, a degree of preliminary education which will ensure a broader capacity, a more successful facility, a grander conception and comprehension of duty, and yet more splendid achievements in the line of our profession than we can now boast of. We have much reason to be grateful for the noble action of our National Government some years ago, when it donated a portion of its magnificent domain to education in departments of knowledge vital to both the civil and mechanical engineer, and for the valuable work now being done in those departments of learning especially relating to our profession, under the guardianship and added patronage of the several States in their universities thus endowed. This is a source of hope and light in this direction to which we cannot be indifferent in action or expression; and there is reason to believe that it cannot long be said that our profession in America is without a literature, or that degree of culture upon which both the literature and the largest success of the profession mainly depend. Our older members will soon have passed off the stage of active duty. Many of us commenced our professional career when but one or two of our educational institutions conferred the degree by which our calling is designated. The most of our engineers now start with an advantage which we did not possess, in having received a thorough technical training. I would say to this class, soon to succeed us, that much more will be expected of you in the grand opportunities that await your coming than has been accomplished by us. With this advantage coupled with thorough observation, mental activity, unflagging industry and moral rectitude, a sure way to professional preferment will be found in new and grander fields of duty than we have trod. Many times, under most humble circumstances, will be gained by experience that which will in after years enable you to overcome obstacles that threaten your professional pathway.

Is it not possible that George Stephenson, with head bowed down to the ashes of the hearth in his early home, with eyes peering up into the grate watching the processes of combustion, was then conceiving the idea of the steam blast in the chimney, that which has made the locomotive the agent it is? Who knows butthat then his brain became preg-

nant with the grand idea that bore fruit in after years. when he said that the sun was the primary source through which came the power to swiftly drive the railway train? And are not all possibilities with you, and especially with you in this age and in this land of boundless possibilities? Proud as we may be of the record of the past, who would not live to know the grander record of the future committed to your care? If from any cause you may desire to abandon our pursuit, may we not hope that some of you may leave it, as did Spencer or Tyndall, to enter upon investigations of life and nature's evidences of law, training your minds to see clearly in that far off field of human thought where ours now see but dimly? As the Almighty grants you knowledge of his truth, our profession surely will ever stand ready to thank and remember those who reveal it, and to seize and utilize that truth for the best purpose of man.

On Wednesday afternoon about 324 members and guests embarked upon the Steamer A. J. Wright, and on the invitation of the Falconwood Club, proceeded down the Niagara River to Grand Island. Landing at the very elegant and commodious club-house, the entire party proceeded to enjoy to the utmost the hospitality extended to them. After some time spent in strolling over the grounds, chatting on the broad verandas, and boating on the water, a tempting lunch was served and duly appreciated. No formal speeches were made but the satisfaction of hosts and guests was most evident.

The return to Buffalo was made at "19 o'clock, and by moonlight," according to the programme of Secretary Bogart, but the moon failed to put in an appearance.

On Thursday at 9:30 A. M. the entire party proceeded by a special train to Suspension Bridge, and the now famous Cantilever. Both were examined, criticised and contrasted; the older engineers talked shop, and the younger members devoted themselves principally to caring for the comfort and safety of the many ladies who were in the party, in the passage to and from Canada by way of the two bridges. Upon the arrival of the train in Niagara Falls a bountiful dinner was found awaiting the members and their guests at the Cataract House. After dinner the party went sight-seeing, and Goat Island, Prospect Park and the other points of interest were visited, to the satisfaction of the many who for the first time saw the wonders of Niagara, and to the gratification of the hackmen who benefited accordingly by this rather early influx of visitors.

Upon Thursday evening a reception was given by the Buffalo Club to the members of the Society and those accompanying them. The club-house had been very recently redecorated and furnished; and of the reception itself little more can be said that it was a most pleasant and enjoyable affair; flowers abounded, the toilettes were elegant, the ladies were handsome and the supper one that in appearance and in detail would have graced the tables of Delmonico.

On Friday, about 75 members of the party, accepting the invitation of the Buffalo, New York & Philadelphia R. R., went to Chautauqua Lake, and spent the day there. The reading of papers was resumed at the Y. M. C. A. Hall, in Buffalo, and the attendance of members was large, notwithstanding the temptation held out to them of attractive excursions of professional and general interest.

The first noteworthy event of the morning was the introduction of the following resolution by Mr. Charles Latimer of Cleveland, O.:

Resolved, That should the President of the United States select the president of the society to be one of the representatives at the international conference at Washington, in October next, to decide upon the best prime meridian and best method of counting standard or cosmopolitan time, he is not to be considered committed by any action of the society heretofore made of advocating the commencing of the daily account of hours from either midnight or noon.

Two or three standard time enthusiasts entered demurrers, and spoke vigorously on the conflict of custom *vs.* common sense, but the general sentiment of the convention was in favor of leaving their presiding officer to the exercise of his own discretion and the resolution was carried by a vote of 23 to 5, many members not voting.

The first paper read was by Mr. E. L. Corthell, upon the "South Pass Jetties; Ten Years Practical Teaching in River and Harbor Hydraulics." Mr. Corthell gave a most interesting and satisfactory statement of the actual results obtained by the application of the jetty-system to the mouth of the Mississippi, the most gratifying feature to all concerned being the fact that instead of the 26 and 28 ft. required by the contract, there were practically 35ft. of water in the channel today. The benefit, commercially, to New Orleans and the Great West was spoken of, and the significant fact noted that while 22,000 bushels of corn was a cargo, ten years ago, 90,000 bushels, and many bales of cotton had recently passed to the Gulf aboard a single ship.

Mr. Benjamin Reece, of Toledo, O., read a paper upon "The Management of Forces Engaged in Track Repairs." The author advocated the selection of energetic young men for the position of Road Masters, in preference to the promotion of those who were originally section men or foremen. While admitting the benefit of judicious promotion from the ranks, he thought that the interests of the road were best assured by appointing men who had served an apprenticeship under the eye of the Road Superintendent, who were familiar with his system of accounts and reports, and who would not be so liable to work directly with the men instead of directing their labors. The more responsibility thrown on the individual foremen, the more rapidly their fitness would be made apparent, and the more uniform the general condition of the road-bed. Mr. Reece went into the detail of his system, and illustrated this system by the form of reports in use and the organization of his track forces. Mr. Chas. Latimer, in briefly discussing this paper, put in a plea for the "bald-headed" trackmen, and thought that better results were obtained, and more faithful service, when these men saw before them some prospect of advance and promotion, beyond the daily pittance usually awarded them.

In the absence of the author, Secretary Bogart read a paper upon "The Radical Enlargement of the Artificial Highway connecting the Lakes and the Hudson River," by Elnathan Sweet, Jr., State Engineer of New York. Mr. Sweet proposed the enlargement of the entire canal and the practical rebuilding of its eastern end, to such an extent that the largest lake vessels could pass through it from Buffalo to the Hudson, and also the control of this water way by the State. The proposed change of location would give in one part of its length a level 115 miles long. The author admitted that the expense of such enlargement and rectification of route would be enormous, but the commercial gain would be correspondingly great. Mr. Francis, of Lowell, suggested, as of proper application in this case, the extreme simplicity of the plan adopted by the promoters of the Cape Cod Canal, where a canal is being built upon bonds issued by one man and taken in payment of a contract let to this same individual.

Mr. Wm. J. McAlpine, one time State Engineer of New York, advocated an enlargement of the canal to such an extent as to reach the maximum carriage of freight with the minimum cost, but halted before arriving at the extravagant dimensions of a ship canal. He reminded the members that canals, *per se*, were little improved since the days of the ancient Egyptians; that while the advance had been radical and great in all other directions, in transportation by sea and over our railroads, engineers had neglected the water ways. A reason for this was found in the fact that as soon as a canal-engineer had displayed any particular

(*Concluded on page* 314)

SELECTED MISCELLANY.

PLOWING BY STEAM—FARGO, Dakota, May 27.—A number of heavy wheat-growers from all parts of north Dakota were here to-day to witness an experiment in plowing by steam, and express themselves enthusiastic over the result. A traction engine drew eight plows, turning the sod four inches thick as evenly and as well as could be done by horse-power, and at the rate of over twenty-five acres a day. It will mark a new era in wheat-growing, as it will enable farmers to plow at a cost of not more than $1 an acre.

THE greatest whispering "gallery" in the world is that of the Grand canyon, Colorado. For years this chasm has been a matter of surprise to prospectors and miners on account of its wonderful transmissions of sound, and it has only been since the advent of the railroad that any definite idea has been entertained of the distance it travels within its walls. A train of cars crossing the bridge at the Needles can be plainly heard on a quiet day at Cottonwood island, a distance of 84 miles. The fife and drum at Fort Mojave is distinctly heard at Bull's Head, a distance of 84 miles. The report of the sunrise gun at Fort Mojave can be heard at El Dorado canyon, a distance of 96 miles.

IRRIGATION is a matter of such consequence in California that a State convention has just been held to consider the subject. Irrigation is only in its infancy in the State, and yet there are from 200,000 to 250,000 acres of irrigated lands in the San Joaquin Valley alone, and there is no part of the State, except the extreme northern countries, in which irrigation is not a live question. California, says the San Francisco *Alta*, is more in need of the fertilizing agency of artificial irrigation than most of the countries in which the art has been practised since the beginning of historical times, but the matter of accomplishing it is a difficult one, owing to conflicting interests.

THE India canals are a distinctive feature of the country. They are splendidly built, being intended principally for irrigation, although having locks so as to make navigation possible. The largest and most important one is the Ganges Canal, which cost the Government over 2,000,000 pounds sterling. It is about 300 miles long, runs out of the Ganges and proceeds into the Ganges again. When the subject of building it was agitated, the interesting natives vowed they would never for an instant tolerate it, tapping as it did the sacred river of the Hindoos. Then when the work was actually begun they changed their tactics and gravely declared that water would not remain in or flow through the canal. When the fallacy of this position was shown, they receded from it and contented themselves with solemnly asserting that no native would ever avail himself of the improvement. It is now in full operation, however.

MR. WILLIAM H. VANDERBILT'S treasure vault, in which he recently stowed away some $100,000,000 in securities, is one of the most redoubtable works of defense on the American continent, though you may not be entirely certain of that by surveying his mansion from the outside. Its foundations were blasted out of the rock; the front wall is 5 ft. in thickness, and the side and rear walls 3 ft., the materials used being pressed brick with brown stone trimmings. The beams, girders, and main pillars are iron, incased in fire proof material. The doors, window frames, and minor partitions are iron, marble, and glass. No wood is to be found in the structure. The great vault is 36x42 ft., of wrought iron, steel, and Franklinite iron, is imposing in strength and proportions, and is situated on the ground floor. Its four outer doors weigh 8,200 pounds each, and have every effective and known improvement in defensive devices. A massive wall of masonry surrounds the iron work. The vault, which is burglar, fire and water proof, constitutes a distinct building in itself.

WHAT some people are pleased to call the irony of fate seems to have visited the Arc de Triomphe. The stone of which it is composed is now found to be unable to stand the weather and is fast crumbling away. The celebrated bas-reliefs of Rude, the sculptor, are becoming more and more mutilated, and the question is seriously discussed whether it would not be possible to renew the face of the arch stone by stone. One of the curious facts about the bas-relief is that Rude worked at them in a sort of glass cage suspended against the face of the arch, and until they were finished and the cage removed could not realize what the effect would be of the whole. Of course, in such a matter one mistake would have ruined the whole, and would have been irreparable. The celebrated Chevaux de Marly are also in a bad way, and endeavors are being made to have them replaced by copies and the originals put under shelter. A sort of society for the protection of ancient monuments and objects of public interest has just been formed in Paris, and here are two objects they might nurse with advantage. One cannot, however, help feeling that there is some mysterious connection between the Arc de Triomphe and the glories of France, which it would be somewhat out of place to try and destroy by doctoring the arch.

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CAN any of our readers give us the address, in the United States, of Messrs. Brown and Honore, contractors for public work in Buenos Ayres, referred to in last week's ENGINEERING NEWS?

PITTSBURG, PA., pay the following salaries: Assistant City Engineer, $150 per month; assistant engineer in charge of surveys, $125; assistant engineer, $90; transit men, $75 each per month; rodmen, $60 per month; seven inspectors, $75 each; clerk of registry, $125 per month; assistant clerk, $75; draughtmen, $83.33; messenger, $40 per month.

C. P. HUNTINGTON, the great railway magnate, is quoted as saying "he never would be satisfied until he was instrumental in building a railroad across the great Sahara Desert, that it was a work he had long contemplated, and, if his health permitted it, he would yet live to see this, the greatest achievement of his lifetime, fully accomplished."

WHY was the "separate system" of sewerage, as applied at Keene, N. H., and proposed for Charleston, S. C., so conspicuously referred to in the annual address at the Buffalo Convention? And why were Memphis, Norfolk, and Buffalo itself, so completely ignored?

Keene is rather an insignificant town of less than 7,000 inhabitants, and in Charleston the scheme has yet to betested; its construction has hardly been commenced in fact.

ACCORDING to the *City Record* there are in the employ of the Park Department one engineer at a salary of $3,000 per annum, a "Topographical Engineer and Acting Engineer of Construction" at a salary of $3,500, an architect at $250 a month, an assistant engineer, at $1,900 a year, an assistant engineer and draughtsman at $1,500, 11 other assistant engineer, at $1,500 salary each, another at $4 a day, an "assistant" at $1,500, another at $1,200, and two more at $100 per month; two draughtsmen at $1,200 and $1,000 per year each, two "assistants" at $3 per day, and five other "assistants at $2.50 per day each, besides chainmen, axemen, rodmen, etc., Yet with this force of engineers, draughtsmen, architects, and assistants, costing the city over $50,000 a year, the Park Department applies to the Board of Estimate and Apportionment and gets $5,000 with which to make "preliminary surveys" for a new bridge over the Harlem River. The "surveys," Gen. Viele explained to the board, are not for the land at the approaches, but for the bridge itself. It might be well to employ an engineer to make "surveys" of the engineer force of the Park Department and ascertain, if possible, what it is doing to earn $50,000 and upward a year.—*N. Y. Times.*

The U. S. Coast and Geodetic Survey.

Since its reorganization in 1843, the Coast and Geodetic Survey has been a bureau of the Treasury Department. From time to time attempts have been made by other departments to obtain control of it, particularly by the navy. Two years ago, in fact, the Secretary of the Navy, in his annual report, recommended that Congress should transfer it to his department, and an organized attempt was made to secure the passage of an act for that purpose, which, however, was signally defeated. This year an attempt of a more insiduous character is in progress in the nature of a rider to the annual appropriation bill, whereby the interior triangulation of the Coast and Geodetic Survey is to be hereafter conducted by the U. S. Geological Bureau, and the charting of the shores be done by the navy. This attempt to break up the organization of one of the most efficient departments of the government is made covertly at a late day of the session, when there is little opportunity either for discussion on the floor of Congress, or for the Coast and Geodetic Survey to properly defend itself against the attack. It is to be hoped, however, that it will be able to resist it successfully, for certainly the surveyors and civil engineers of the country would greatly regret to see disruptured a bureau which has for so many years carried on such thorough and valuable work as has been accomplished by the Coast and Geodetic Survey.

The first superintendent of the survey was Hassler, a Swiss mathematician of eminence. The next was Bache, whose name is familiar to every surveyor on account of his magnetic observations and studies, but whose greatest works was the development of the organization and methods of the survey by which it has been enabled to conduct its operations so efficiently and economically. He was succeeded by Peirce, the greatest geometer probably of our land and time. After him came Patterson, a distinguished hydrographer, whose executive skill in conducting the affairs of his office is said to have been remarkable. Upon his death in 1881, Hilgard, who had been for thirty years the principal assistant in the service, and who is eminent in science as a mathematician and observer, was appointed superintendent. During more than forty years the work of the office has been carried on under these five scientists until the very mention of Coast Survey suggests to every surveyor a high ideal of precise engineering work.

About 1878 the U. S. Geological Bureau was created in order to collect information concerning the mineral deposits of the territories, and to make scientific studies concerning rocks and fossils. This bureau has done good work in this direction. Its chief, Major Powell, has in particular made valuable contributions to our knowledge of the customs, languages, and ethnology of the Indian races of the northwest. It does not follow, however, that because the Geological Bureau has done good work in this special field, it should therefore be entrusted with the execution of the geodetic triangulation of the country. On the other hand it would seem to follow that the special study of geology and ethnology would be incompatible with the precise observations and exact computations required in geodetic work, on account of the different methods of reasoning and the different qualities of mind required. We take it for granted, therefore, that the Geological Bureau in seeking to possess itself of the interior triangulation of the Coast and Geodetic Survey, seeks merely to control the operations, and would of necessity be compelled to execute the work with the present *personnel* of that office. If this is the case, it is difficult to see what good could be accomplished by the change.

The engineering work done by the Navy Department has not usually been of a character to command the high respect of the scientific world, and for this reason, if for no other, we should regret to see any part of the survey of the coast entrusted to it.

We do not propose to touch upon any political reasons for or against the transfer of the Coast and Geodetic Survey to the navy and the Geological Bureau; indeed, so far as we know, there are none. The Coast Survey Office has kept out of politics, its assistants have been selected and promoted from one grade to the other for merit only, and in this respect all agree that it presents a true ideal of what the civil service of a nation should be. It is not alleged that its work is not well and economically done. The importance and value of its labors as set forth in its thirty-three annual reports is not gainsaid. The necessity of its interior triangulation as a basis for the future maps of the country is admitted. It would seem, then, that the safest method would be to hold fast to that which has been proved to be good, and not to disrupt an efficient organization because other departments are ambitious to control it.

Reasons Assigned for Discharging 2,500 Employees of the Missouri Pacific.

Railway companies, as extensive employers of assistants of various grades and capacities, are often exposed to losses and inconveniences arising from the bad conduct or incapacity of some of the numerous persons in their service. Particulars relating to the extent or nature of these losses are rarely published, and the public is most likely to hear of a few of them by current news descriptive of defalcations or "accidents," which were caused by ignorance, neglect, or recklessness. There must, however, be many cases of wrong-doing that do not inflict notorious injuries upon travelers or transporters, but which must receive proper consideration from officials of effective lines. The number of such instances, in proportion to the number of employés, varies very much, with the degree in which they are reliable, well trained and well disciplined. It is to be hoped that a record recently published and discussed by the St. Louis *Globe-Democrat*, which shows that during the twelve months ended April 1st, 1884, about 2,500 employés in the operating departments of the Missouri Pacific (exclusive of the Wabash) were discharged for cause, represents an exceptionally inferior force. The causes of discharge were drunkeness in fully 20 per cent. of the cases reported; 15 per cent. of those dismissed were strikers; and neglect of duty, incompetency, dishonesty, and insubordination are the principal causes for the other dismissals. The record embraces all classes of employés, from station agents, conductors, and engineers to wipers, yardmen, and laborers. The classes which proved most troublesome on the Missouri Pacific were the brakemen, and the following specimens of their offences are given:—

Drunk and fighting; collecting cash from tramps; quitting and bringing suit for pay; going under an assumed name and refusing to work; carrying passengers in box cars and collecting fares; robbing cars; forging passes; asleep on duty; insulting a lady; lying to get money; general worthlessness; getting left; hiding tramps on freight trains; impudence; dead beat; promiscuous lying; stealing supplies from other cabooses; causing collisions; failing to flag trains; never on time; drunk; incompetent; beating board bills; joining strikes, etc., etc., *ad infinitum*.—*Railway World*

PERSONAL.

C. G. FORCE, JR., City Engineer of Cleveland, favored our office with a hasty sight of his pleasant countenance on the 17th.

GEO. H. BOYNTON, Asst. Eng. C. R. I. & P. Railway, Davenport, Ia., favored us with a call on Monday, while en route home from the Buffalo Convention.

JNO. B. WESTON, formerly of ENGINEERING NEWS, now editor-in-chief of the *American Engineer*, spent the first part of the week in this city, visiting his relatives and friends and renewing old acquaintances. He left for Chicago on Tuesday evening.

MR. FRANK BARTLETT, for many years connected with the Denver & Rio Grande and Denver & Rio Grande Western Railway Companies as Division Engineer, has accepted a position on the Canadian Pacific. This road is to be congratulated upon obtaining the services of so competent an engineer and genial gentleman.—Denver *Tribune*.

THE death is announced (as occurring at Colwyn Bay, England, on the 12th of last May) of DR. ANGUS SMITH, Government Inspector of Alkali Works for the United Kingdom. He was the inventor of a preservative composition for coating cast-iron pipes, and the preparation is largely used on gas and water mains laid in the British Islands and America.

ROBERT GORDON, MEM. INST. C. E., Superintendent of Public Works, Henzada, British Burma, India, favored us with a call on Tuesday. MR. GORDON is spending some months in this country with the special purpose of acquainting himself with the latest improvements in American Railway practice, as adapted to the peculiar wants of British India. He is a most genial gentleman, and expresses his great satisfaction with his recent attendance at the Buffalo Convention, and for the many pleasant courtesies of which he has been the recipient from American Engineers since his arrival in the country.

C. L. CORNWELL, C. E., has been appointed Assist. Supt. of the Louisville and Portland Canal at Louisville, Ky., to fill the vacancy caused by death of CAPT. H. N. ADAMS, who was accidentally killed on a steam yacht on May 7th. MR. CORNWELL'S wide experience as an engineer on railroad and other engineering works will especially fit him for his new position, in connection with which is the improvement of the Falls of the Ohio River. Mr. CORNWELL comes highly endorsed by the Lou. & Nash. R. R. where he served for several years in charge of heavy work and tunnels during construction of their Knoxville Extension in 1880 to 1883, and during summer and fall of 1883 was in charge of Ashtabula Harbor improvement Lake Erie.—(*Exchange.*)

WM. B. KNIGHT, the popular City Engineer of Kansas City, Mo., favored us with a call on Wednesday. New York City is MR. KNIGHT'S former home; he is a graduate of Rensselaer Polytechnic Institute; has been a member of the American Society of Civil Engineers since January, 1875, and has just been re-elected to his present responsible position, his office being virtually the most important one of all the city offices except that of Mayor, and his personal election in the recent political contest being the great local party issue. The tax payers of Kansas City have reason to be thankful that the administration of their public works is in such efficient and trustworthy hands as those of their present City Engineer.

OBITUARY.

FRANCIS PIDGEON, a well-known old resident of this city, was killed at 11.50 A. M. on the 12th inst, on the Hudson River Railroad track, between High Bridge and the bridge of the New York City and Northern Railroad. He was for many years an extensive contractor in the way of bridge building and grading railroads and other highways in the neighborhood of New York, and was attending to some contracts of that nature when the accident occurred. An employé of the New York and Northern Company saw Mr. Pidgeon walking along the track in a southerly direction with his head bowed, apparently absorbed in thought, as the Croton train approached, which left the Grand Central Station at 11.30 A. M. Mr. Pidgeon evidently failed to hear the warning shouts and whistles. He was struck right in the face by the engine and instantly killed.

Mr. Pidgeon was born of Iri h American parents 60 years ago in the Eleventh Ward, and in his youth, as well as in middle and later age, few men were more widely and favorably known among all classes, especially those engaged in any capacity in the ship and yacht building trades, and among people de voted to out-door sports. He was regarded as the father of the game of base-ball in this section, and was the founder of the well known Eckford Club; but when the sport degenerated into a business he lost all interest in it. Among yachtsmen he was looked up to as a master, and his judgment in the matter of models was highly prized and always bowed to implicitly by the well known yacht-builder, George Steers, who was his life-long friend. Mr. Pidgeon was one of the old "Forty-niners." He went to California round the Horn, and returned with that historic band across the isthmus. Later on he visited San Francisco again by the way of the isthmus and returned overland. He was a rigorous student of science, art, and literature, and a fine musician. Paintings by his own hand adorn his parlors and those of some of his friends, and he got the credit of being the inventor of the only successful steam traction plow ever made. He possessed an exceedingly genial disposition, won devoted friends, and was almost passionately attached to his family. He leaves a wife and five grown up children, his eldest a son, Frank Pidgeon, Jr., being extensively engaged in his father's business.

LITERATURE.

Fifth Annual Report of the Fort Wayne, Ind., Water-Works, for the year ending April 30, 1884. M. J. ZOLLINGER, Engineer.

Total receipts from all sources $21,427.35; total expenditures $17,176.51. The total construction proper, to date, has cost $257,616.77. The daily average of water pumped in the year was 1,217,730 gallons. The cost of pumping servic , per million gallons, was 12.33\frac{7}{10}$; cost of total ordinary maintenance, per million gallons, 19.94\frac{4}{10}$; cost of interest and maintenance, same quantity, 55.72\frac{8}{10}$; ordinary revenue, per million gallons, $44.87. Miles of pipe in use, 27$\frac{8}{10}$; hydrants, 220; meters, 80. The average meter rate is 9$\frac{1}{10}$ cts. per 1,000 gallons.

Report of the Commissioners of Sewerage and Water Supply for the City of St. Johns, (East Side), and town of Portland. For the year ending Dec. 31, 1883. Gilbert Murdock, Chief Engineer and Superintendent.

According to the report of the superintendent, the rainfall for the year was 39.86 in. and the total precipitation (snow water included) was 50.732 in. The snow fall for the year measured 102.52 in., and the average for 22 years is 96.25 in.

Bi-daily observations have been made, since 1880, of the temperature of the water at Little River Reservoir, and daily, of the water in the distribution system. In the reservoir the observations are made in the Gate-house, morning and evening, at two feet below the surface, the water at this point is taken from near the bottom of the reservoir and is protected from the sun's rays, so that it may be taken as fairly representing the body of water entering the mains.

The temperature of the water in the reservoir ranged during 1883 from 33° in January, February and March to 68° in August. The water in the city distribution ranged from 33.5° in March to 65° in August, declining to 36° on December 31st. The annual average at the reservoir was 45.15°, and in the mains, 45.36°. The annual average of the temperature of the air, for 1883, was 38.65°.

The lowest temperature recorded in St. John since 1860 was 22° below zero, on February 8, 1861, and January 27, 1866; the highest was 87° above on June 26, 1866. In 1883 the frost, in some places where the snow was blown away, penetrated 7 ft. 2 in. below the street surface, and a number of the city mains were frozen.

A map accompanies the present report showing the General Plan of Public Sewers; 2594 lin. ft. of these new sewers were built in the last year, the total length now built being 76.883 lin. ft. These are upon the general plan adopted in 1866, when the management of the sewers was transferred from the Common Council to the Commissioners of Water Supply.

Underground Telegraphs.

Subterranean wires are ordinarily considered as a resort to escape the number of wires in city streets. Germany and France are the only countries which have used them on a large scale for general telegraphic communication. Between 1875 and 1881, 3,400 miles of underground wires were laid in Germany, connecting 220 places with Berlin, and containing 23,210 miles of wire. In 1881, the French Minister of War asked for $1,600,000 to lay 3,135 miles of underground telegraph, making the estimated average cost $573 a mile. About 2,500 miles have been laid, and the whole will be completed in 1886. The cost, which includes iron channel, wire and labor of laying down, is much greater than that of aerial wires, but maintenance is less, as is disturbance from electric storms.

The exact cost of putting up wires in this country is given in no telegraph reports and rarely presented separately. The special wire used by the Postal Telegraph Company is $175 a mile against $35 for the iron wire used by the Western Union. The 75,686 miles of wire operated by the Western Union, June 30, 1866, cost less than $100 a mile on the poles; but the wires now in use cost much more. The chief argument for the use outside of cities of the more costly system abroad is its military value, which does not exist here.

The New York Legislature, following the example of Chicago and the practice of most foreign cities, has passed a bill requiring all telegraph and telephone wires to be placed under ground by November 1, 1885, at the expense of the companies. Practical methods exist for doing this on the main streets and for the sheaves of wires entering and leaving town along the telegraph lines. Nor is the expense of doing this work under these circumstances, great in comparison with the business done on the wires. The real difficulty is in dealing with the one, two or three wires which thread single streets. Even in New York City not one-fourth of the wires are in trunk lines, and the same is true of other cities. A year ago it was estimated that the expense of putting all the wires in our cities underground would reach $25,000,000 half the current value of the Western Union Company. In Paris, where the telephone wires are under ground the annual subscription of a telephone is $120. The chief objection, however, to wires is against their existence in numbers along the principal streets, and a compromise will probably be reached, under which these will be put under ground and the single wires left above.—*N. Y. Sun.*

(CONCLUDED FROM PAGE 311.)

merit he was transferred to the seemingly more important railroad work. In the paper discussed, it was shown that water transportation cost about one mill per ton per mile, as opposed to five mills for general freight and four mills, for the cheapest tolls, upon the railroads. Mr. McAlpine warned the railroad engineers that the day must come when they would have to more generally compete with the lesser tariff; that with improved water ways, built and conducted in accordance with modern ideas, they would find in them a formidable rival for the transportation of freight from the fields of the West to the Eastern seaboard. Secretary Bogart supplemented this paper by reading a letter upon "Lake Commerce," written by Capt. M. M. Drake, of Buffalo, pointing out the great advance in ship building upon the lakes in recent years.

As an exceedingly pleasant addenda to the morning's proceedings, the audience of engineers had introduced to them Mr. F. Cope Whitehouse, son of the late Bishop Whitehouse of Illinois. This gentleman, in a short impromptu lecture, explained to the members some of t e results of late personal investigations in the Valley of the Nile; he was lead by the writings of Herodotus, Diodorus Siculus and Strabo, to seek for and locate the somewhat mythical Lake Moeris, and, according to his own theory, backed by the most eminent authority of modern times, he has found *the* lake, and made plain many heretofore conflicting statements. Mr. Whitehouse was witty and entertaining, and in support of his statements produced and translated a copy of an ancient Egyptian *papyri*, the original of which was so old that Moses himself may have studied geography from it in the University of Memphis.

At the afternoon session, Mr. Clemens Herschell of Holyoke, read a short paper upon the "Cost of Steam Power." Mr. J. J. R. Croes followed with a paper upon "Water Rates;" by taking a typical house, with frontage, height, rooms and fixtures adapted to the many forms of ratings in use, Mr. Croes compared by a chart, the up-and-downs of water-rates as charged in some 204 towns investigated. This rating was for an average household, and the result in the 204 towns may be stated as follows: Average annual charge, for an average family, $22; if works are owned by the town, $18.22, if owned by a private company, $22.61. The rates differ in different sections; in the East, if owned by the town, the average annual charge is $17, if owned by a company it is $22.08. In the Central States, the town charge is $17.68, the company charge $24.42, In the States west of the Mississippi, the average town charge is $26.34, and the company charge, $29.78. The extreme rates for the class of house taken were $5 and $72, the highest rate being charged on the Pacific Coast. This paper was discussed at considerable length by Mr. C. B. Brush, of Jersey City, B. S. Church, Chief Engineer of the New Croton Aqueduct, and Thos. J. Whitman, Water Commisisoner of St. Louis.

The next paper was read by the Secretary, and was on "Experiments on Structural Steel," by E. B. Dorsey. Mr. Jas. Christie, of the Pencoyd Iron Works, also presented a paper upon the "Strength and Elasticity of Structural Steel, and its Efficiency in the form of Beams and Struts;" both papers were briefly discussed and test specimens were exhibited by Mr. Christie.

Mr. Robert Gordon, M. Am. Soc., C. E., M. Inst. C. E., of British Burma, exhibited plans of the new National Line Steamship *America*, and explained to the members some of the peculiarities of her construction; he was invited to prepare a formal paper upon the subject for presentation to the society.

A progress report of the Committee upon the Preservation of Timber, O. Chanute, Chairman, was presented, and the professional papers remaining upon the list were read by title. The last general meeting of the convention was brought to a close by another informal talk from Mr. Whitehouse. The Pyramids, and their location and construction were the topics of his remarks, and as in the morning session, he interested, pleased, and edified all present. Mr. W. is evidently a man of extreme culture; has abundant means and a thirst for investigation into the mysteries of our world's past history; by his erudite and patient research he has gained recognition from many learned bodies of England and the Continent.

On Friday evening, the members of the American Society of Civil Engineers, present at this Convention, tendered a reception, at the Genesee House, to their friends in Buffalo. Many distinguished citizens were present, and the evening was delightfully passed in discussing the solids and the liquids provided, and in making and listening to complimentary and witty speeches from the Buffalonians and their late guests. A very handsome, gilt-edged, embossed and chocolate tinted *menu* bore testimony to the taste of Messrs. Whittemore, Michaelis and Bogart, who, on the part of the Society, had charge of the reception.

On Saturday the Convention disbanded, and the members scattered, with much handshaking and many expressions of good-will, to their widely separated homes. The Eastbound members left Buffalo, at 8.30. A. M., in the same special train provided by the generous management of the N. Y., West Shore & Buffalo R. R. which brought them from New York, and were again under the personal charge of the efficient engineers of that road, Messrs. Katté, Corthell and Blondin.

A delay of some hours at Pittsford, N. Y., resulted from an accident to a freight train ahead, which was occasioned by a broken wheel. As the excursionists were mainly railroad men, to whom occurrences of like nature were not new, the halt was taken philosophically and patiently by the older men, while the younger members of the party, with their lady friends, over-ran the village, gathered, begged, and stole, we fear, floral decorations for their companions, and rather regretfully obeyed the summons to depart, when the "four whistles" finally sounded.

With a halt at Syracuse for a good dinner and a stop at Kingston for supper, the train sped on its way to New York, arriving at 3 A. M. on Sunday morning.

Any account of the trips from, and back to, New York would be incomplete without bearing witness to the general comfort of the journey. The cars were elegant in their appointments and the road-bed as smooth and easy-running as if it had had years of patient work expended upon it, instead of being, as it is, an affair of yesterday. The passengers were the most critical in matters appertaining to railways, that could have been selected, and the many warm and hearty expressions of commendation from these experts must have been pleasant to the ears of the company's engineering officials.

In partial recognition of the many courtesies extended to the Society, the following resolution was passed upon the train on the home-trip, and copies sent to the President and Directors of the road, and of the North River Construction Company:

The members of the American Society of Civil Engineers desire to express their thanks to the management of the New York, West Shore and Buffalo Railway, and particularly to Mr. E. L. Corthell, member of the society and chief engineer, and the officers who were in direct charge on the several trips to and from Buffalo, and to express their gratification at finding a road so recently constructed, which has lately passed through its first winter's disturbing influence, in such admirable condition.

As engineers they notice that the location, grades, and curvatures are judiciously adapted to the needs of a great trunk line instead of being made subservient to local demands.

As passengers they are particularly struck with the perfection of the road-bed and luxury and comfort o the rolling stock.

For the members present.

WILLIAM J. MCALPINE,
JULIUS W. ADAMS,
THOMAS D. LOVETT,

D. MCN. STAUFFER, Sec't'y.

Last, but by no means least among the many pleasant reminders of the Convention is the very elegant souvenir presented to the members present by the local committee. A simple description cannot do justice to the taste of its authors, and as a Buffalo production it is one that all can well be proud of. It is entitled "Some Things in and about Buffalo," and in contents it is devoted to a detail of the public buildings, parks and industries of the city; the illustrations are phototypes and they are superb specimens of the art. In a word, it is the handsomest souvenir yet presented to the American Society of Civil Engineers.

Engineers' Club of Philadelphia.

RECORD OF REGULAR MEETING, JUNE 7, 1884.

President Wm. Ludlow in the chair, twenty-seven members and three visitors present.

The President announced, in relation to the question of new and enlarged quarters for the Club, that a house could be obtained in the fall, in Girard Street, and requested the members to be prepared to discuss and act upon the subject at the next meeting.

Mr. Wm. H. Ridgway described a simple crane, consisting of a cylinder hung from the jibs of an ordinary foundry crane, and using the steam directly to hoist the load; and also an elevator, in which water, receiving pressure from the direct application of steam acting upon a piston carrying a rack, gave motion to a shaft carrying a pinion and drum wheel.

Mr. C. Henry Roney exhibited specimens of American Sectional Electric Underground Conduits as laid in Philadelphia, described the method of their construction in detail, the difficulties encountered in avoiding the present underground works, the manner of introducing and arranging the wires, and the behavior of the e ectric currents therein.

Prof. L. M. Haupt, supplemented his paper of May 17th, upon Rapid Transit, by an interesting collection of statistics of the growth of the city from the time of the "pack horse" to the present, and showed, by maps, that his previous statements were verified by these statistics.

Mr. A. E. Lehman exhibited to the Club a model of a new protractor, and described the invention and the improvements he has made in it. It consists of a combination of protractor, T square, scales, etc., which may be worked separately or together. As a protector only, it is complete, being graduated to degrees and fractions thereof and provided with a vernier reading to three minutes. It can be used, like an ordinary paper or ivory protractor, for hasty plotting, and combines triangles and scales in one instrument. For careful and precise work it is said to be equal to the best special instrument, and to be no higher in price.

Mr. E. V. d'Invilliers read a paper on "Some Characteristics and the Mode of Occurence of the Brown Hematite (Limonite) Ores in Central Panama," taking for his field of illustration the Lower Silurian limestone valleys of Centre Co. He described the anticlinal structure of these valleys, and the great erosion, ærial and sub-ærial, which these rocks, (6,000 feet thick) have undergone, influencing the position and character of many of the present ore deposits. He applied this principle to the different ferrifero..s limestone beds and explained how this effect was aided by the alternate rise and fall of the anticlinals along the trend of their axes. He noted three varieties of ore: 1st. The wash and lump hematite of the Barrens. 2d. The true limestone "pipe ore." 3d. An intermediate *transition* variety. The first is always associated with the sandy

magnesian beds low down in the series of No. II, or below 5,000 feet beneath the overlying Hudson River Slates of No. III. This class shows rounded ore and flint balls and tough, barren clay, and are secondary or derived deposits of irregular shape. They have been tested 100 feet deep, and contain from 45 to 53 per cent. iron and .051 to .113 phosphorus. The almost total absence of bisulphide of iron is noticeable. Cost of mining about $1.50 per ton. The *transition* variety was assigned a position in the formation from 3,500 to 5,000 feet below the slates. They are characterized by a more calcareous clay, are compact, amorphous, liver colored ores, containing from 40 to 49 per cent. iron and from .115 to .365 per cent phosphorus. The *pipe ores* occur usually higher in the limestones than either of the other two, but in this county *below* the 400 feet of upper Trenton layers. These ores occur *in situ*, between parallel walls of limestone; in plate-like masses, scales, or as cylindrical pipes in bunches 8 or 10 feet long, while feathering out both in line of strike and dip. The deeper banks show the repeated occurrence of crystals of iron pyrites in all stages of metamorphism. They occur at great depths, and show from 45 to 53 per cent. iron and from .100 to .185 per cent. phosphorus. The flint or quartz grains accompanying them are rarely water worn, and this clay is very calcareous and easily washed, not requiring the jigging necessary for cleansing the lower ores. Cost of mining these ores varies from 90 cents to $1.25 per ton.

Prof. L. M. Haupt called the attention of the Club to a Bill, pending in Congress, to consolidate the U. S. Coast and Geodetic Survey with the Navy Department.

Captain S. C. McCorkle, of the Coast Survey, who was present, explained the effect that its passage would have upon the future of the work; the President, William Ludlow, gave, from his own experience and knowledge, the reasons why this change was contemplated. The Secretary read his correspondence with Hon. Sam'l J. Randall upon the subject, and expressed what he believes to be the unanimous sentiment of the Civil Engineering profession of the country, against any interference with a Survey, the perfection of whose results is proverbial, and against any increase of the already unwise and unjust discrimination of the Government against thoroughly competent *Civil* Engineers, and in favor of a class who often (but with *notable* exceptions) have, comparatively, but little ability, and whose only claim is that the Government has attempted to educate them and must, therefore, seem to provide them with something to do.

As no action could be taken until the next Business Meeting, the Chair appointed Prof. L. M. Haupt, Mr. Rudolph Hering and the Secretary, a Committee to prepare a resolution upon the subject for presentation to the Club at that meeting.

Canadian News.

TORONTO, June 12, 1884.

EDITOR ENGINEERING NEWS:—Our new pumping engine tenders have now been received over a year, and the contract has not yet been awarded. There were four tenders received as follows:

1. Holly Manufacturing Co.
2. Jas. Watt & Co., England.
3. Edward P. Allis & Co., Milwaukee, Wis.
4. Inglis & Hunter, Toronto.

These tenders were referred to Kivas Tully, C. E., Toronto; John Kennedy, C. E., Montreal; John Fensom, M. E., Toronto. Mr. Tully reported in favor of the Inglis & Hunter engine, Mr. Kennedy for the Allis engine, and Mr. Fensom in favor of the Holly engine. The Committee then referred the matter to the City Engineer, who reported in favor of accepting the Inglis & Hunter engine. The whole matter has been referred to the Council, and a final decision is expected this week.

We are doing a great deal of work on the streets, sewers, etc. We have on hand about five and one-half miles of pavement (cedar) and tenders will shortly be called for the construction of a sewer on the line of Garrison Creek, estimated cost about $75,000.

The citizens also worked in favor of a by-law for $160,000 on June 5th, the money to be spent in laying new water mains, building new fire halls, etc.; this work is required owing to the annexation of Brockton and Riverside.

The city of Hamilton awarded contracts yesterday to a Detroit firm for laying about 45,000 sq. yds. of cedar block pavement.

The principal streets of Toronto are now lighted by the electric light.

C. H. RUST.

CORRESPONDENCE.

Salt Water and Gravel.

Special Correspondence Engineering News.

NEW HAVEN, June 17, 1884.

EDITOR ENGINEERING NEWS:—What effect, if any, has salt water on gravel which is to be used with cement to make a concrete for a foundation for sewer work; also, if brick dipped in salt water will prevent the setting of the cement to any remarkable degree.

MATTHEW KEHOE.
Contractor, 217 Congress Ave.,
New Haven, Conn.

The "Best Medium."

Special Correspondence Engineering News.

16 and 18 CHAMBERS ST., N. Y., June 16, 1884.

ENGINEERING NEWS PUB. CO.

GENTLEMEN:—I send the cash for your bill for advertising. I am gratified at the number of responces which have come to our "adv." for Telford roadmaking in Franklin, New Jersey. The NEWS is evidently the "best medium" for that sort of advertising.

Yours very truly,
H. G. PROUT.

Water Supply and Waste in Cities.

To the Editor of Bradstreet's.

SIR:—The notification by the Commissioner of Public Works sounds again the note of warning of the almost annually recurring danger of a short supply of water for the city of New York, with all the inconveniences, losses, and peril to property and health involved.

The history of the water supply of New York is that of all other cities having a public service, viz., that with multiplied attachments, and little or no efficient regulation of the use of water, the consumption increases in a vastly greater ratio than the increase of population, and in consequence the means which, according to any rational computation of requirements, were designed to be ample for many years to come, are soon found totally inadequate. In some cases, the visible sources of supply themselves are literally drained to the dregs.

Baltimore has been compelled, within a few years, to expend $10,000,000 or $12,000,000 for new works. Philadelphia, though her trouble is largely one of quality also, has for many years endured the evils of a short allowance, and is now making surveys for a new supply which will cost $15,000,000 or $20,000,000. Brooklyn, having drank up all her water, is endeavoring to suck fresh sustenance out of the already thirsty soil of Long Island by extending her conduits ten or twelve miles eastward, at a cost of $4,000,000 or $5,000,000. New York is wrestling with the throes of her mighty problem, which will involve an expenditure of $15,000,000 or $20,000,000. Boston, having but a few years ago made as she supposed comfortable provision for a generation to come, is peering into her rapidly-depleting basins and anxiously wondering whence she is to fill them.

In all these cases and numerous others the main source of the present difficulty is perfectly obvious, and the engineers and other city officials having cognizance of the facts are unanimous in attributing the enormous increase of consumption less to the free or even lavish use of water, whether for domestic, industrial or protective purposes, than to the reckless and unscrupulous waste of the supply.

It will probably be admitted without argument that a bountiful supply of water is among the most vital needs of a modern community, more especially when the aggregation of population is great and the manufacturing interests are of importance. New York and Philadelphia standing first in both respects are typical. The former with a single conduit designed to deliver 90,000,000 gallons only, is drawing 100,000,000, and the reservoir was lowered in the past month two-and-a-half feet, with the summer still to come; Philadelphia having multiplied her pumping machinery is delivering 72,000,000 daily, with the prospect that the consumption will in July and August reach 100,000,000.

In both cases the quantity of water delivered daily per capita is in excess of seventy gallons. Compare this with what has been over and over again computed by hydraulic engineers as the amount actually required, viz., from 30 to 50 gallons according as the water is to a greater or less extent used for ornamental and sanitary purposes. Neither city has many fountains, and neither pretends to any systematic flushing of sewers at all. It may, therefore, be safely assumed that 40 gallons per day per head of population is ample for all purposes for which the water is legitimately used, this amount being divided nearly as follows.

	Galls.
For domestic uses	20
For manufacturing purposes	15
For sprinkling streets, etc	2
For fountains	2
For fire purposes	1
Total	40

It follows that about 57 per cent. only of the consumption is used, and 43 per cent. is wasted. In other words, the New York supply is sufficient for a population of 2,500,000, and that of Philadelphia for 1,800,000, and that the restriction of waste, could it be fully controlled, would add its own amount to the available supply.

This enormous waste arises from many causes, leaky mains and pipes, defective appliances of all kinds, lack of supervision of public openings, and the perpetual flow from horse-troughs, bar-rooms, hotels, private houses, etc. In addition is the immense loss through factories and mills, where the pipes are constantly flowing, and which do not even shut off the water when the works are closed.

There are but two practicable methods of checking this waste, viz., by a system of inspection and enforcement of penalties, and by measuring and charging for the quantity taken The former plan involves domiciliary visiting, always cumbersome and objectionable, by an army of inspectors, subject to both obstruction and improper influences in the discharge of their duties, and, unless thoroughly systematized and maintained and aided by indirect instrumental determinations, is, in the nature of things, an approximation only to an effective method.

Actual measurement is preferable as being more exact, automatic, effective and equitable. The water meter is merely a sleepless and tireless machine, not susceptible to bribery or violence without discovery, requiring little attention and recording actual consumption regardless of the disposition made of the water which passes through it.

The two systems may be compared by supposing a given establishment to be furnished with gas at an annual rental and its econom-

ical use dependent upon the carefulness of the occupants and an occasional visit by an inspector.

It is sometimes said that water should be as "free as air," and in truth it is to any one who chooses to procure it for himself, as light is free to him who goes to bed at dark; but he who wishes either light or water supplied to him when and where and in such amount as he shall choose must manifestly pay for it, and the meter will enable the department to make out just bills, and at the same time hold the water taker responsible for the waste due to carelessness, willfulness or defective appliances. When this system has been intelligently carried out as in some of the better managed cities, such as Providence, the results show that the legitimate consumption of water for all purposes is from 30 to 40 gallons. The argument that an undesirable economy might be exercised among a class of population whose use of water should be encouraged, may be met by fixing a minimum allowance and charging by meter for all beyond that.

It is natural, perhaps, that city officials should turn their attention to drawing from new sources and increasing the machinery of their department rather than undertake the unpopular and thankless task of restricting waste. No one knows who has not attempted it how difficult it is to correct abuses of long standing. Few citizens are intelligent or liberal enough to voluntarily aid in securing a public benefit, or necessity even, if it must be accomplished at the cost of any inconvenience or restriction to themselves. Touch the purse-string, however, and it can be done. With the meter registering waste defective appliances will be repaired, the carlessness of servants and employés corrected, the water-closet will have a proper flushing tank instead of a constant flow, and the water will not be used in winter to protect a badly laid pipe from freezing or the owner from a plumbing bill.

The waste from these sources, though of no great apparent amount in a single instance, when multiplied by the immense number in use represents a formidable quantity, which, having been brought at great expense from the source of supply, flows to tide-water without having served any useful purpose whatsoever.

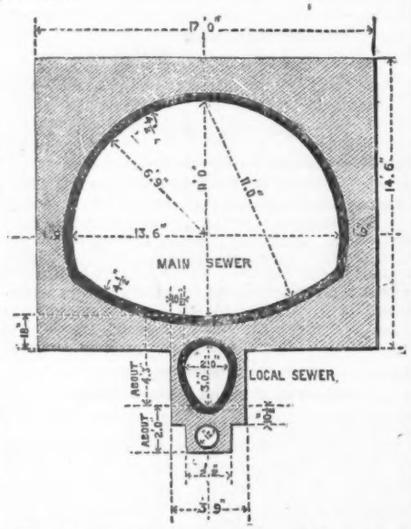
There are numerous patents for water meters, and no one is yet fully perfected and adapted to all localities, but there are three or four which in service have proved themselves useful and satisfactory machines when properly applied, and no other system has yet been discovered so simple and effective to restrict waste and systematize the business of furnishing water.

WILLIAM LUDLOW.
Chief Engineer Philadelphia Water-works.

The Deptford Storm Overflow Sewer.

Although the main drainage system of London was nominally completed some years ago, yet it has received a steady extension ever since, principally with the object of carrying off the storm-water which was apt to flood the low-lying districts when the rainfall exceeded a certain amount. The latest addition to the scheme is the Deptford storm overflow sewer, which was yesterday visited by the Metropolitan Board of Works, prior to its being taken over from the contractors, Messrs. S. Pearson & Son, of Bradford, Yorkshire, and Delahay street, Westminster. This piece of work has a special interest in that it is the largest sewer in London, and probably in the world, being 11 ft. in height and 13 ft. 6 in. wide, and hence its construction marks an advance in sanitary matters.

Deptford is a point where most of the sewage of south London converges. First there is the main drain running through New Cross, Deptford and Greenwich to Crossness, and consisting of two waterways each 10 ft. 6 in. in diameter, side by side. Then there is a large sewer which conveys the storm-water from the Lewisham district, which was for formerly periodically flooded by the River Ravensbourne, and finally there is a low level sewer which drains the district near the river, and terminates at the pumping station where its contents are raised into the main outfall sewer. In the original scheme, and indeed up to the present, advantage has been taken of Deptford Creek, which penetrates for a considerable distance southwards from the river, to carry off the storm-water when the sewers have been unable to accommodate it. This, however, has been attended with great inconvenience and often times with loss, as the influx of water has been so great as to carry away the barges moored by the warehouses along the river, and in other ways to do serious damage. The new sewer, therefore, has been constructed to divert the storm-water from the Creek and to deliver it directly into the Thames below low-water mark, where the accumulated matter which is always scoured out of the drains during a freshet, will be as little preceptible to either sight or smell, as possible.



The length of the main portion of the work is 3050 ft. Besides this there are 90 ft. of connection to the existing sewer, and 230 ft. of outlet works on the shore. It is laid in a mass of concrete 17 ft. wide by 14 ft. 6 in. high, and is lined with 4½ in. of bricks, made by the High Brooms Brick Co., of Tunbridge Wells. The invert is struck with a radius of 11 ft., from a center situated at the crown of the arch, and the latter has a radius of 6 ft. 9 in struck from a center 4 ft. 3 in. above the floor. These two curves complete the cross section, which has an area of 134 square feet, while the cubical contents of the sewer are nearly 3,000,000 gallons. The thickness of the concrete is, at the sides 1 ft. 1½ in., at the bottom 1 ft. 4½ in., and over the crown 1 ft. 7½ in., while the average depth of the excavation was 22 ft., and the fall 1 in 767.

The construction of the work necessitated the removal of the existing drain along the route, and the provision of a new one for the accommodation of the house drainage, as the new sewer is entirely limited to storm water. To this end an egg-shaped conduit was constructed below the invert, sloping from each end towards the place where the new sewer crosses the low-level sewer mentioned above and discharging into it by a vertical shaft. As these lower drains receded from their outfall, rising in level towards the invert, they were changed to pipes of gradually decreasing section, which were finally laid at the side, and not below the main sewer. At the outfall the sewer is composed of three parallel channels formed side by side on the foreshore and covered with cast-iron plates and concrete, their ends being carried below low-water mark, and contracted to insure a good effluent velocity. The tide is prevented from entering the sewer by cast-iron flap doors, both at the river end and also at the creek—for there is still an overflow into the creek—in case the new channel should prove unequal to the demands made upon it. The connection with the outfall sewer is closed with sluices which are raised by hand when communication is to be established between the two.

The entire work has been carrried out by Messrs. Pearson and Son in a most systematic manner, and although they have passed through a crowded district and under the railway, they have been able, by the exercise of great care and skill, to avoid the necessity of any underpinning. The whole of the material was lifted by steam cranes running upon rails over the excavations, and the timbers used for shoring have been withdrawn as the work progressed without giving rise to any settlement in the adjacent ground. The concrete was made from the best Portland cement, and from ballast obtained in the neighborhood, the gravel raised from the excavation not being clean enough for the purpose.—*Engineering, May*, 23.

The Department of Parks and Mr. Van Winkle.

By the retirement of Mr. Edgar B. Van Winkle from the position of Chief Engineer of the Street and Sewer Depa tment of the Department of Public Parks, the city of New York loses the services of a most competent and faithful officer. For the past six years Mr. Van Winkle has fulfilled the duties of an exceedingly arduous and responsible position in a most efficient manner, in the face of obstacles which can only be thoroughly appreciated by those who know the nature of the work, and the difficulty of doing anything under a four-headed commission of antagonistic politicians. The territory embraced in the jurisdiction of this department is as large as the original city to which it was annexed in 1874. The wise foresight of some of its prominent residents had caused a thorough topographical survey of the district to be made in advance of its annexation to the city, but under the supervision of the Park Department. The street system and the sewerage and drainage had to be established for these 13,000 acres of rugged and diversified territory, cut up into numerous irregular villages, each with its independent system of streets as laid out by the original owners of the tracts, and without grades established, pavements laid, or sewer built. Through this territory was scattered a population 40,000 souls.

The task before the Park Department was to provide a system of streets and parks suitable to its future development, and not interfering too greatly with property divisions as to destroy the value of the property and its existing improvements, to devise plans for its sewerage and drainage, and to carry them out as demanded, in a systematic manner, and to prepare maps showing accurately the boundaries, areas, and ownership of every separate parcel of property for purposes of assessment and taxation.

Between 1874 and 1878 the general scheme of laying out was determined on, the plans for the streets over about half of the area were prepared and adopted, the general system of sewerage planned for a limited area, and some sewers built.

Mr. Van Winkle had been connected for two years with the development of the street and sewerage system, when in 1878 he was placed in charge of all the work, with reduced appropriations, a small force, and an ignorant and inharmonious commission. In spite of these obstacles he carried on the works with great efficiency, and has now completed the laying out of the territory on an admirably devised system, has constructed ten miles of sewers, graded five miles of streets, established by stone monuments the exact lines of over 100 miles of streets, and prepared for the tax commissioners maps of over 600 "blocks," besides a great amount of miscellaneous work not easily classified. The only complaint which can be made against the conduct of this work, is that the chief engineer has been so interested in his work that he has remained at his post in spite of the meagre appropriations made for its support, and to accomplish his purpose of completing the system, has consented to serve year after year for a compen-

sation far less than is paid any similar grade of official in other branches of the Government. On the completion of the plans establishing the system of streets and parks, and a large portion of the sewerage, he voluntarily retires to take a well-earned rest from official duties, leaving a record for ability, industry, and integrity, which, it is to be hoped, his successor will emulate. *Sanitary Engineer.*

THE COAST SURVEY.

Shall its Splendid Record be Eclipsed by a Transfer to the Navy.

WASHINGTON, June 16.—The proposition now being considered in the Appropriations Committee, to abolish the coast and geodetic survey as a separate service, and to transfer its hydrographic work to the Navy Department, and its geodetic work to the geological survey, is attracting a good deal of attention in official and scientific circles.

The act of February 10, 1807, which created the coast survey, gave the management and direction of it to the Treasury Department, and it remained in the control of that department until 1817, when the bill making appropriations for the work contained the proviso that the survey should be conducted only by naval officers. The results of this change were not satisfactory, and in 1832 the survey was reorganized, and the conduct of the work reassigned to the Treasury Department. In 1834, the coast survey, as an organization, was transferred to the Navy Department by an executive order—the matter being at that time within the control of the President—and remained under the direction of that department until 1836. The experiment, however, seems to have been unsuccessful, for, after two years' trial of naval management, the survey was retransferred to the Treasury Department, and has been a bureau of that department ever since.

The question of assignment to the Navy Department, however, continued to be agitated at intervals for many years. In 1843 Congress authorized the appointment of a special board to consider and report upon the expediency of putting the survey once more under the control of the navy. The board submitted a new scheme of organization, and recommended that the survey be under the control and be considered a part of the Treasury Department.

Attempts to transfer the survey to the Navy Department were made in Congress in 1848, 1849 and 1850, but they all failed, and the question was not raised again for many years.

In December, 1882, the Secretary of the Navy, in his annual report, recommended the transfer to his department of the coast survey, the revenue marine, the life-saving service and the light-house board. The heads of these bureaus were requested by the Secretary of the Treasury to make to him such statements with regard to the proposed transfer as should seem to them proper. Their replies were published as Treasury Document No. 395 in January, 1883, and the arguments presented in opposition to the transfer of any of the bureaus were such that no action was taken.

The question of transfer, however, so far as it relates to the coast survey, has again been raised (this time in the Appropriations Committee), and it seems probable that the transfer will be recommended. It is argued in support of the proposed change that the scientific survey of the coast has now been virtually completed; that the work which remains to be done is mostly hydrographic work, and that it can be performed by the Navy Department as efficiently as by the survey bureau, and with a great gain in economy.

Friends of the coast survey, on the other hand, assert that the principal object of the Navy Department in seeking to obtain control of this work is to have more places for its redundant officers, and that the ordinary duties of naval officers do not prepare them for the execution of scientific work of this character, inasmuch as the skill and experience required can be obtained only by years of familarity with the subject. The education that fits a man to command a vessel no more fits him, they maintain, to conduct a trigonometric survey than the teachings of a medical college would fit a man to conduct a difficult law case.

Another forcible reason, it is said, for maintaining the survey on a civil basis is found in the fact that in such an organization there is a feeling that the work and the workers must stand on their merits. The work is not likely to be slighted, as it might be by workers who knew they held life positions and could not be removed except for misdemeanor.

As for the work which the coast survey has done for the country, it can point, its officers say, to its system of charts, covering every harbor of prominence in the country, and nearly all the shore line between them; to its publications relating to territorial magnetism and its magnetic charts; to the tide table of the ports on the Atlantic, Gulf and Pacific coasts, published annually; to the coast pilots for the Atlantic and Pacific coasts and Alaska; to its explorations and discoveries in physical hydrography; to its transit of Venus, eclipse and longitude parties in Alaska and foreign countries, to the perfected system of weights and measures which it has introduced throughout the United States, and to its work on the Isthmus of Panama, when the Navy Department, which had charge of the entire work, was compelled to call upon the coast survey for the execution of such part of it as related to land operations.

Finally the officers of the survey ask whether it is likely that such work as this can be better done by officers who are unfamiliar with trigonometric methods, inexperienced in the use of instruments and unfamiliar with the history of the previous explorations of the coast, and whether official or personal courtesy will permit the transfer from a department of an important bureau without officially calling upon the head of that department for an expression of his views on the subject.—Baltimore *American.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 305*)

DCLII., STONEHAM AND WAKEFIELD, MASS.

Stoneham and Wakefield, Middlesex Co., Massachusetts, in lat. 42° 25′ N., long. 71° 5′ W., are on generally high ground. Stoneham was settled about 1620, and was incorporated a town in 1725.

Water-works were built for the joint supply of the two towns in 1883, by a private company, after plans of Percy M. Blake, C. E., taking the supply from Crystal Lake, which covers an area of 60 acres. The water is pumped by two Knowles steam pumps, having a daily capacity of 1,000,000 gals. each, to a cylindrical wrought-iron tank 62 ft. high and 40 ft. in diameter, having an elevation of 200 ft. above the pumps, 125 ft. above Stoneham, and 185 ft. above Wakefield. A fire pressure of 110 lbs. is furnished by direct pumping.

The combined distribution is 21 miles of cement lined wrought-iron pipe of 12 to 4 in. in diameter, with 110 fire hydrants, 240 gates and 630 taps. Service pipes are of enameled wrought-iron. The towns pay $50 yearly for each hydrant. The daily consumption in 1883 was 250,000 gals.

The population in 1880 was, for Wakefield 5,547, for Stoneham, 4,890; it is now said to be 7,700 and 5,300, respectively.

Cyrus Wakefield is President of the company and B. B. Burbank, Superintendent.

DCLIII. MODESTO, CAL.

Modesto, California, in lat. 37° 30 N., long. 121° W., the county seat of Stanislaus County, is situated on a generally level and fertile farming and grazing district, half a mile north of the Tuolumne River. It was settled in 1870.

Water-works were built in 1876 by a private company, the supply being taken from ground water.

Two wells each 10 in. in diameter, have been bored to a depth of 116 ft., and yield 1,200,000 gallons in 24 hours. The water is pumped by two Blake pumps, one of 10 in. steam and 9 in. water sylinder, and 12 in. stroke, and the other of 12 in. steam and 8 in. water cylinder and 14 in. stroke, lifting 112 ft. to tanks holding 100,000 gallons.

Distribution is by 5 miles of sheet iron pipes of 6 in. diameter with 25 gates and 250 taps. There is no fire service. The daily consumption in the summer months is 800,000 gallons and in the winter 100,000.

The population in 1880 was 1,693, it is now said to 2,700. The capital stock of the company is $20,000. There is no bonded debt. The cost of the works has been $20,000. Stimpson P. Rogers is President and Isaac Perkins Superintendent.

DCLIV. MICHIGAN CITY, IND.

Michigan City, La Porte Co., Indiana, in lat. 41° 40′ N., long. 86° 40′ W., is on Lake Michigan at the mouth of Trail Creek.

Settled in 1833, it was incorporated a city in 1835. Water-works were built in 1875 by the city, after plans of Daniel Kennedy, the supply being taken from the creek near its mouth and pumped by a Worthington steam pump of 1,500,000 gallons daily capacity, lifting 80 ft. to a reservoir, constructed of wood, 28½ ft. in diameter and 14 ft. in depth, having a capacity of 64,481 gallons and being from 40 to 72 ft. above the city. By direct pumping a fire pressure of 100 lbs. is given.

Distribution is by 7 miles of cast-iron pipe of 10 to 4 in. diameter with 78 fire-hydrants, 14 gates, 3 meters and 80 taps. Service pipes are of iron and lead.

The daily consumption in 1883 was 180,000 gallons. The population in 1880 was 7,366, it is now stated as 8,500. The works have cost about $40,000. The bonded debt is $35,000 at 7 per cent.

The expenses in 1883 were $5,700, and the receipts $1,638.35. The works are managed by a board of three trustees, John Rankawitz is Superintendent.

DCLV. FARIBAULT, MINN.

Faribault, Minnesota, in lat. 44° 20′ N., long. 93° 15′ W., is the county seat of Rice County and is built on low ground at the junction of Cannan and Straight Rivers, the surrounding hills rising from the valley from 100 to 200 ft.

Settled in 1853 it was incorporated a city in 1856.

Water-works were built by a private company in 1883, after plans of George E. Beach, taking the supply from a well 20 ft. in diameter and 19 ft. deep sunk to sand-stone rock, which is overlaid by a saturated gravel stratum 12 ft. thick, yielding 3,000,000 gallons daily. The water is pumped thence by a compound duplex Deane pump of 14 and 26 in. steam, and 10 in. water cylinder, and 24 in. stroke, lifting 235 ft. to a circular reservoir 80 ft. in diameter and 20 ft. deep holding 750,000 gallons and being 219 ft. above the city.

Distribution by 7 miles of cast-iron pipe of 14 to 4 in. diameter with 60 fire-hydrants and 43 gates. Services are of lead and wrought-iron. The city pays $5,010 yearly for hydrants.

No taps have yet been put in. The population in 1880 was 5,415, it is now given as 7,500.

The capital stock is $200,000, the works will cost $140,000.

The bonded debt is $80,000 at 6 per cent.

G. E. Beach is President and Superintendent.

WATER.

THE subject of bringing the water from the carding machine spring to the public square by underground pipes is being agitated by our citizens. The project is supposed to be feasible at a moderate cost.—Sparta, Tenn. *Expositor.*

AN interesting legal question is likely to be decided at Glen Falls, N. Y. The proprietor of the recently burned opera house in that city threatens the municipal authorities with a suit for damages because the water supply was deficient and the authorities were negligent in remedying the same.

AT the Pennsylvania State Department, last week, a charter was issued to the Jermyn Water Co., of Jermyn, Lackawanna county, with a capital of $30,000. A charter was also issued to the Bellwood Building and Loan Association, of Blair county, with a capital of $300,000.

A COMPANY are issuing proposals to build the Uncompahgre Irrigating Canal, in Colorado, at a cost of $200,000. It will be about 25 miles long, and 36 ft. wide in the bottom. It leaves the Uncompahgre River about 6 miles east of Montrose, in Montrose Co., Col., and runs in a generally north-western direction into Delta Co. Walter H. Graves, of Denver is Chief Engineer.

A PROSPECTUS has been issued of the Albuquerque Water Co., in New Mexico; bonds $80,000. The work is said to be under contract, and includes, a wall 50 ft. deep and 20 ft. in diameter; a reservoir of 4,250,000 gallons capacity; and two Holly pumps of 1½ millions capacity. Albuquerque has 7,000 inhabitants, or with the old town adjoining, 10,000. Capt. Gustave Dyes, was the engineer who planned the work.

NEW HAVEN, June 15.—The great artesian bore, upon which the Winchester Arms Company has spent, it is said, $25,000, bids fair to prove a failure. It is now over 2,000 feet deep and has not as yet struck water, while a portion of the drill has fallen to the bottom and has, it is feared, effectually blocked further progress. The well has been the wonder of persons from near and far, and it had been intended to continue work on it till water was reached.

ON the 13th inst, the Michigan Pipe Company of Bay City Mich., contracted with the village of Lorain, Ohio, to furnish for their water-works 1275'-10", 1650'-8", 17850'-6", and 8950'-4", Wyckoff Patent Water Pipe. Special castings, 40 double disch hydrants, and 34 valves and valve boxes, also to lay the pipe and set hydrant valves and special castings. Mr. Walker, of Port Huron, Mich., contracted to furnish a set of Walker's pumps and boilers, also to furnish and lay the 1000' of 10" suction and 300' of 6" river crossing.

WHEELING, West Va., June 16.—An accident occurred at the water-works this evening by which one man lost his life. A well 52 feet deep, intended to receive a new pump, had just been completed, and the men, 10 in number, had been hoisted to the surface, when the timber lining gave way on all sides and the well caved in. Of the men standing on the edge of the pit John Smith and Patrick Skullon were hurled into the hole and buried from sight. Shallon was dug out alive, but his companion was buried under 30 feet of earth and rocks

THE Pipe Committee of Pittsburg, Pa., Councils met last week in the Water Superintendent's office, and affirmatively reported water pipe for Atwater, Sheridan, Clark and other streets. The general committee will act on their recommendation at their next meeting.

THE town of Brookline Mass., has voted to extend the water mains in Irving and St. Paul St. eets, and to issue bonds for $100,000, in order to establish additional water-works for a high service system for the supply of estates not accommodated at present.

NEW FIELDS FOR WATER-WORKS.—A number of the coke works of the Connellsville, Pa., region suffer more or less inconvenience because of a scarcity of water, and some of the operators have been actually obliged to curtail their output on this account. One of the possibilities of the future is a water-works for the coke region. With a central pumping station at Connellsville, water could be distributed all over the region at a very reasonable expense if all the operators would join in the movement. The Frick Co. have already made some progress in this direction. Labor and cars are both plenty, though the former is being somewhat thinned out by the new railroads being built in this section.

NEWS OF THE WEEK.

Contracting Miscellany.

IN the suit of Patrick J. Sexton against the city of Chicago for extras on the city hall contract, Judge Smith entered judgment for $56,680 in favor of the plaintiff.

BRESDEN & CHAPMAN have started a new establishment in St. Louis, Mo., to be called the Western Bridge and Iron Works. They will pay especial attention to bridge work.

THE Cambria Iron Company, in Johnstown, Pa.., is working on an order for 15,000 tons of steel rails for the Cincinnati, New Orleans and Texas Pacific Company. They are sixty-pound rails.

MESSRS. ORMAN & CROOK of Denver, Colo., railroad contractors have shipped their large graders' outfit of laborers, mules and carts by the Union Pacific and Chicago, Milwaukee & St. Paul railways, bound for Winnipeg, where they have made a contract for two million dollars. In this contract are five tunnels, aggregating a distance of six and one-half miles.

CONTRACTS for building a new bridge over the Piscataquis at East Dover have just been awarded. The bridge will be of iron and manufactured by the Berlin Bridge Company of Connecticut. It will be one span 150 feet. Should the season be favorable it is expected the bridge will be open for travel before winter.

BIDS will be received until November 15, 1884, for the construction of the following sewers at Winnepeg, Manitoba: 4,500 feet, 5 feet in diameter; 4,500 feet, 6 inches in diameter; 3,000 feet, 4 feet in diameter; 2,000 feet, 3 feet 6 inches in diameter; 2,000, 3 feet in diameter; 4,000 feet, 2 feet 6 inches in diameter; 4,000 feet, 2 feet in diameter.

THE Clifton Iron Company has let contracts for the building of a very large charcoal blast furnace at the new town of Jenifer, Ala., on the Anniston and Atlantic Road.

JOSEPH E. THROPP is putting in at his iron furnace at Edge Hill, Pa., a Taylor-Langdon ore roaster to desulphurize the rich Jersey ores, which are low in phosphorus and make excellent iron, but are graded so high in sulphur that without being roasted they cannot be used profitably. By this change it is hoped not only to improve the quality of iron which is rated first-class in the market, but to increase the output of the furnace, which is now making from 44 to 49 tons a day. Formerly it made about 30 tons a day. This will be the fifth roaster of the kind put up in the United States and their are now only two others in use.

ailroads and Canals.

THE City Council of Nashville Tenn., has decided on the erection of a new bridge between that city and Edgefield to be thrty-two feet wide, including passage ways and trusses.

PUEBLO, June 12.—Carlile, Corrigon & Co., in connection with Mr. Rankin, have brought suit against the Denver & Rio Grande railway for over $50,000 on account of a breach of contract by the railroad company.

THE preliminary survey of the proposed railroad from Fitchburg, Mass., to Manchester, N. H., is finished. The maximum grade is 52 8-10 ft. per mile, and this grade is only for short distances. The survey has been made by G. F. P. Day, under the supervision of Chief Engineer E. K. Turner of the Fitchburg railroad. The course of the alignment is published very fully in the Fitchburg papers.

UNIONTOWN, PA., June 9.—Work was begun on Saturday last on the new Baltimore and Ohio Railroad line from the terminus here south. The road will run through the eastern portion of the town, and will be built this summer as far south as Fairchance, a distance of six miles. It will run on the east side of the Southwest road, and the two roads will only be a few feet apart.

WICHITA, June, 15.—The Wichita, McPherson, and Denver Railroad Company have finished voting subsidies along their line in this county and covering twenty-three miles west of the Arkansas River. About $100,000 in aid has been voted by Wichita and Sedgwick counties. Active preparations are being made by the management to begin the work at once. A corps of engineers are now running the final survey, and a large amount of right of way has been secured.

ONTARIO & Quebec R.R. from Toronto to Perth about two third ballasted, "Sink holes" near Sharbot lake giving trouble: stations along the line nearly completed; terminal stations at Toronto and W. Toronto Junction, also engine house well under way. Freight is now moving over the road to and from the lake Superior steamers and Montreal. Expect line to be opened regularly in July. Preliminary surveys made for the extension from Ingersoll to Detroit river at Windsor. Surveys also being made for extension east from Smith's Falls to Montreal, also for branch line from Toronto, Grey and Bruce Division to Wingham 41 miles.

ALL work on the projected branch of the N. Y. Central Railroad, to extend through the lower part of Lockport, N. Y., and increase the facilities of the manufacturers located there, has ceased. A strong, compact bridge had been extended across the canal and gave much assurance to the manufacturers; but the people refused to grant the company the right to use the streets, which refusal occasioned delay and final suspension of operations. The manufacturers need the road very much and will probably exert most strenuous efforts to secure its completion.

THE survey of the Georgia Midland and Gulf railroad, says the Columbus Ga. *Enquirer* of recent date will begin at this city to-morrow. The surveyors have already arrived, and are just from Mexico, where they have been surveying Vera Cruz division of the Mexican Central raiload. Mr. J. D. Trammell will be in charge of the corps, and will be assisted by Messrs. T. W. Persons, R. B. Ross and J. H. Persons. The line will be run out from the city between Bealwood and Wynton range of hills —the route surveyed by the old Atlanta Air Line corps. The survey will be pushed rapidly to completion, and if the people do their part, it will not be long before actual work on this orad will be begun.

A PROJECT is on foot to cut a road through the Savannah river swamp from Ellentou S. E. to the nearest available point in Georgia, and to establish a ferry across the river so as to increase the trade of Ellenton. A Committee has been appointed to raise money for theobject in view and to select a route.

BERRIEN SPRINGS, Mich., June 13.—Arrangements have been made between a capitalist of Indianapolis, Ind., named Johnson, and the officers of the St. Joseph Valley railroad, whereby Johnson is to begin work toward completing the road between this place and St. Joseph and between Buchanan and South Bend, Ind. It it a narrow-gauge track, and will be completed as such. The road is to be finished both ways before September next. The extension between Buchanan and South Bend will be built first. Johnson is a practical railroad man, and will come on with teams, etc., of his own, but some of the grading, none of which is very heavy, will probably be subject to Benton Harbor, Mich., contractors, named Collins & Murphy, if they desire to take it. The right of way is all secured. The road is now in operation between here and Buchanan.

ST. PAUL, MINN., June 16.—Great interest is felt here in the meeting of the Directors of the Oregon Railway and Navigation Co. at Portland to-day. T. F. Oakes, Vice-President and General Manager of the Northern Pacific, said yesterday that he believed the company would maintain its present independent position, and would act neutrally toward the Northern Pacific and Union Pacific when the latter shall be completed to a junction with the Baker City branch.

"How about the Kalama branch?" was asked.

"We will ballast it with gravel," said Mr. Oakes, "and will open it to traffic about the time the new transfer boat is ready for service, and this will be in about two months."

"And the Seattle branch?"

"Opening that connection has been indefinitely postponed. The former plan was for the Northern Pacific to operate the road from Tacoma to Stuck River Junction, and for the Oregon Improvement Co. to operate it from Stuck River Junction to Seattle. We had expected to put trains on, but the arrangement fell through; hence the indefinite postponement."

"And the Cascade division?"

"You may say that we expect to build 25 miles east from South Prairie on the west slope of Cascade this summer, and 25 miles west. Twenty-five miles are already built from Ainsworth into Yakima county."

WHAT DOES IT MEAN?—Says the Omaha *Herald:* When the subscription books of the new Nebraska Central Railway were opened at Oakland, recently, the entire capital stock, $15,000,000, was taken by Messrs. Lawson and Sherman, of London, England, the gentlemen about whose movements there has been so much mystery since their arrival in this city some weeks ago. The terms of subscription were 10 per cent. cash, and Messrs. Lawson and Sherman made their deposit with an accepted draft for $1,500,000, on the Canal & Railway Construction Co. of London, which has a contract to build the road. The projectors of the scheme say that construction will be commenced at an early day, and that the road will be pushed to a connection with the Central Pacific. The bill for a bridge across the Missouri at Decatur having been passed, it is presumed that the Nebraska Central will avail itself of the means of getting over into Iowa and connecting with the Chicago, Milwaukee & St. Paul.

THE adjustment of the percentages of traffic in the coke pool still hangs fire. It seems no nearer settlement now than it did months ago. The two old roads, the Balimore and Ohio and the Pennsylvania, still take the lions share, and give the Lake Shore interest, which is represented by the Pittsburg, McKeesport and Youghiogheny road, what they please. The latter will perhaps soon make a change in this condition of affairs. It seems determined to push the Peemickey road into every nook and cranny of the coke region. The surveys are now completed, and the Lake Shore and the Lake Erie roads have jointly subscribed $2,000,000 for this purpose, a sum amply sufficient to put the road in connection with every coke works in the Connellsville region, and give it and its backers much better faciiities than the old roads now enjoy. It is estimated that 50 miles of road would be needed to accomplish the desired end. The sum named would be equivalent to $40,000 per mile, more than the branches can possibly cost. The commencement of this work will no doubt be the signal for a hot fight against the new road, which may liven things up somewhat in the coke region. —*Pittsburg Paper.*

ENGINEERING NEWS: Three months for One Dollar.